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VOL. XXIV, NO. 1 WASHINGTON JANUARY, 1913

THE
NATIONAL
GEOGRAPHIC
MAGAZINE

BEACONS OF THE SEA

Lighting the Coasts of the United States

BY GEORGE R. PUTNAM, COMMISSIONER OF LIGHTHOUSES

THE sea-coast line under the jurisdiction of the United States is 48,881 statute miles, measured in three-mile steps. The general government provides lighthouses and other aids to navigation along all this coast, with the exception of the Philippine Islands, 11,511 miles, and Panama, where the marking of the coasts is maintained by the local governments. In addition, the United States provides lights along the American shores of the Great Lakes, 4,020 miles, and on interior and coastal rivers, 5,478 miles.

The United States Lighthouse Service thus maintains lights and other aids to navigation along 46,828 miles of coastline and river channels, a length equal to nearly twice the circumference of the earth. In this distance *it has 12,824 aids to navigation of all classes, sufficient to place one every two miles around the equator.*

In respect to territory covered and aids maintained, it is much the most extensive service of its kind under a single management. There are 1,462 lights above the order of river-post lights, and there are 762 lights having resident keepers, 51 light-vessel stations, and 438 lighted buoys. The total lighted aids of all kinds is 4,516. There are in all 933 fog signals, of which 510 are fog-signal stations, 43 submarine bells, 124 whistling buoys, and 256 bell buoys. There are 6,281 unlighted buoys, and 1,474 daymarks, or unlighted beacons. There are also 516 private aids to navigation, maintained at private expense, but under government supervision.

This service is carried on through an organization of 19 districts, under a central office in Washington. Each district is in charge of a lighthouse inspector and has a local office and one or more supply depots and lighthouse tenders. In all, there are 46 of these small vessels which carry the supplies to the stations and place and maintain the buoys and light vessels.

About 5,500 men are required for the lighthouse work, of whom 211 are in the executive, engineering, and clerical force, 1,733 are keepers of lights and depots, 1,570 care for post lights, 1,516 are on vessels, and 489 are in the construction and repair force.

The entire personnel is under the civil-service rules, and appointments and promotions are on a strictly merit system. This is of great importance for the maintenance of good organization and rigid discipline in a purely technical service, on the efficient conduct of which is directly dependent the safety of all the lives and all the property carried on the seas and the navigable waters of this country.

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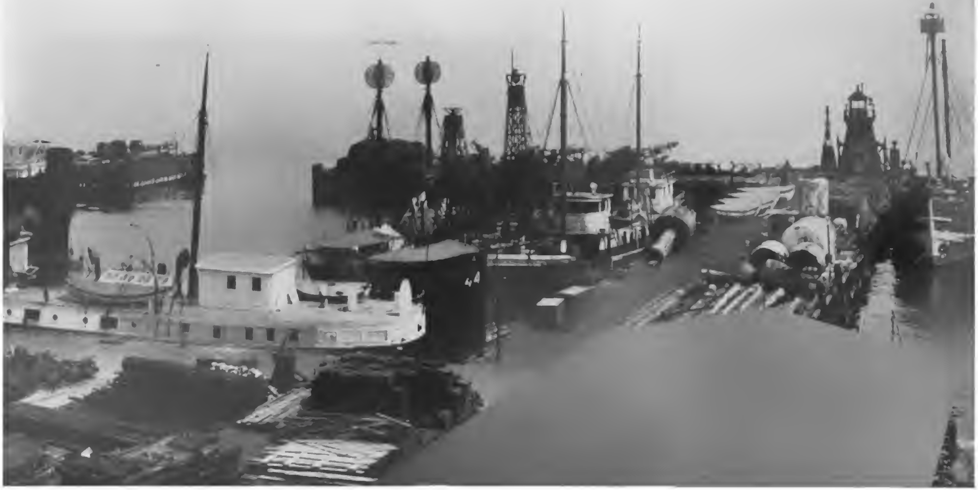


THE GENERAL LIGHTHOUSE DEPOT ON STATEN ISLAND, NEW YORK HARBOR

Lighthouse vessels are here repaired, buoys and supplies purchased, and special apparatus made and tested. Note the variety of gas buoys and other buoys on the dock, and light-ships and tenders in the basin

Latin Lighthouse, after a Medal in the collection of the Marshal d'Estrées.

C. AVG. APAM. COL. IVL. CON.
D D

Latin Lighthouse, after a Medal found at Apamea.

LIGHTHOUSES OF ANCIENT TIMES, AS PICTURED ON ROMAN MEDALS

A lighthouse is mentioned as early as 660 B. C.; the Pharos, at Alexandria, built about 260 B. C., was one of the "seven wonders" of the world, and is estimated to have been about 400 feet high.

The annual maintenance cost of the entire service is close to $5,000,000, and in addition in recent years there has been expended about $1,000,000 a year on new lighthouse works and vessels. This service is supported by appropriations out of the general revenues, and no special light taxes are collected from shipping, as is customary in other countries.

At all important light stations there are from two to five keepers, who maintain a continuous watch of the light at night and of the approach of fog at all times. At less important stations there is but one keeper, or sometimes a single keeper cares for several neighboring lights. The average pay of keepers is less than $600 per year, but they receive also a ration allowance and usually quarters and fuel. The maximum salary at difficult offshore stations is $1,008. For the care of a post light along the rivers about $10 a month is paid, but this requires only a small amount of work each day.

At the general lighthouse depot on Staten Island, New York harbor, shops are maintained for the repair and manufacture of special lighthouse apparatus. This is also a general supply station for the service, supplies and equipment being purchased and tested and experimental and designing work being carried on. Many of the lighthouse vessels are overhauled or outfitted here. There are employed in this depot and offices 253 persons (see page 2).

Light stations and vessels are inspected four times a year, and the districts and offices are themselves inspected from time to time by a general inspector and a traveling auditor.

An accurate cost keeping system has recently been introduced for the entire lighthouse service, so that at the end of the year the principal items of cost for each feature can readily be ascertained and compared. The following are average annual costs of operating various features of the service: Large lighthouse tender, $40,500; light vessel on exposed station, $15,300; important light station, with fog signal, $4,200; same without fog signal, $3,000; river-post light, $90; gas buoy, $100 to $300, according to size and type.

FAITHFUL LIGHT-KEEPERS

Although the pay is small and the life often lonely, the work attracts as a rule an excellent class of faithful men, willing to take large risks in doing their duty and also in helping those in distress. There are many cases of faithful service and bravery, of which the following are a few instances:

The hurricane of September, 1906, did serious damage to lighthouse property along the Gulf coast and a number of lives were lost at Sand Island and at

OLD BOSTON LIGHT (FROM A RARE PRINT OF 1729)

The first lighthouse built in North America, several times attacked, and finally destroyed in the Revolutionary War. The "great gun" on the right was the first fog signal in America (see page 7).

Horn Island light stations; at the latter the keeper, his wife, and daughter being drowned. Twenty-three lights were destroyed by this storm. On October 3 the inspector of the eighth district made this report: "The employees of the Lighthouse Service have, as was to be expected, maintained its credit. I have heard stories of gallant actions, and I have witnessed the uncomplaining manner in which they and their families have taken their great losses and deprivations, also their cheerfulness in beginning all over again."

The keeper of post lights on the St. Johns River, Florida, after being severely injured, went on with his work, as he tells in this report, in May, 1912: "I arrived at the light at 9.30 a. m. I took the lamp out, and as I went to blow it out it exploded and knocked me off the light (22 feet), and I did not know anything until 12 m. When I came to I found the lamp gone. I crawled back to the boat (250 feet), got another lamp and put it on the beacon and lit it. Then came home (8 miles). Injury: broken leg just above the ankle and severe bruised shin and bruised arm and lick on head."

There is a pathetic story of the keeper of Key West light, who after 35 years of service became so absorbed in his duty that he would not leave his task, even for a short vacation, laboring under the delusion that no one but himself could properly care for the light. On a certain very stormy night a ship was wrecked near the fort at Key West. The keeper, then nearly 70 years of age, excited by the storm and the prolonged whistle blasts of the unfortunate vessel, insisted that the wreck was due to the front-range light being out, although it had just been examined by his son and found burning properly. In spite of his feeble condition he procured a lantern and, resisting efforts to detain him, went on foot in the storm to the range light and satisfied himself that it was really burning. He died not long afterward.

The keeper of Van Weis Point light, New York, died recently at the age of 93 years, having tended this light for 52 years.

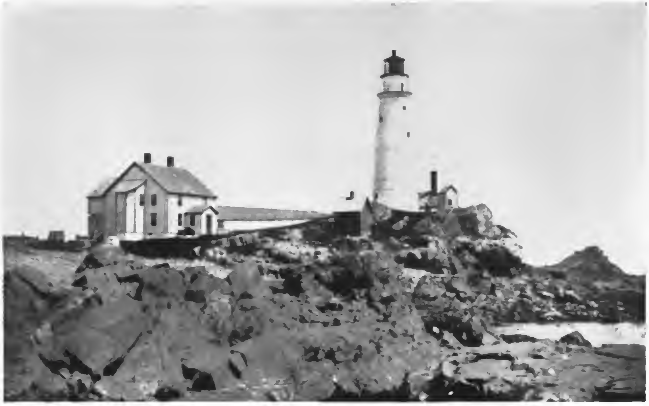
At present there is no provision in this country for the retirement of light-keepers on account of age, long service, or disability resulting from their work.

The keeper of the most distant light in Alaska—Cape Sarichef—returned recently, his first absence in three years. At this station there is sometimes an interval of five months between mails, and the keepers' only neighbor is a trapper, 10 miles away. A light-keeper on the Columbia River, Oregon, has taken only two days leave in 23 years, and one of these two days was for the purpose of being married.

WOMEN LIGHT-KEEPERS

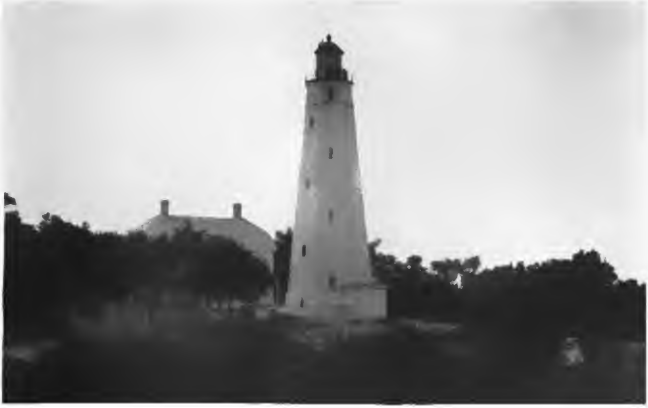
There are a number of women light-keepers. One of these, the keeper of Angel Island light in San Francisco Bay, reported that after the machinery of the fog signal was disabled on July 2, 1906, she "had struck the bell by hand for 20 hours and 35 minutes, until the fog lifted," and that on July 4, when the machinery was further disabled, she "stood all night on the platform outside and struck the bell with a nail hammer with all my might. The fog was dense."

A widely known woman light-keeper was Ida Lewis, who died about a year



THE PRESENT BOSTON LIGHT

Built in 1783 by Massachusetts and ceded to the United States in 1790 (see page 7)



SANDY HOOK LIGHTHOUSE, NEW YORK

This and Cape Henlopen lighthouse, both built in 1764, are the oldest existing lighthouse towers in this country. The walls at the base are 7 feet thick

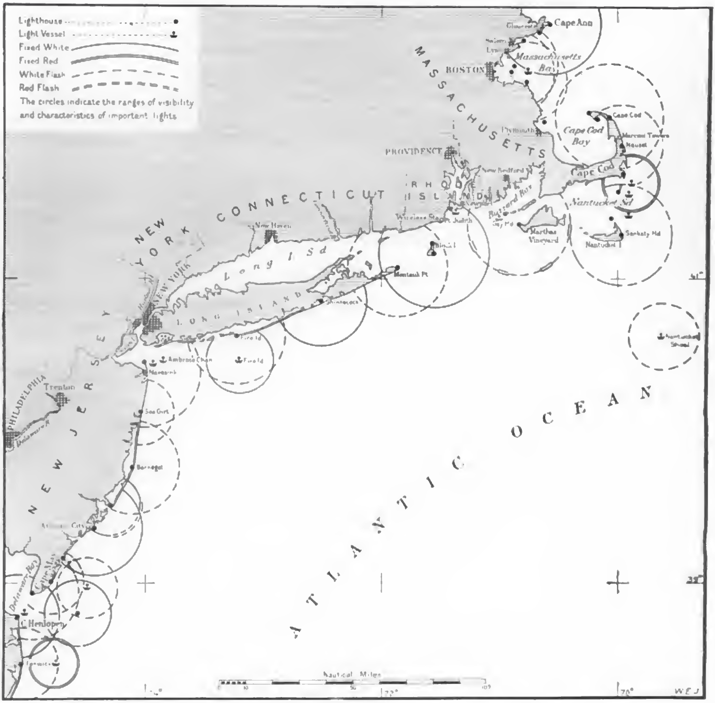


CHART SHOWING THE LIGHTS THAT MARK THE APPROACHES TO THE GREAT HARBORS OF BOSTON, NEW YORK, AND PHILADELPHIA (SEE PAGE 15)

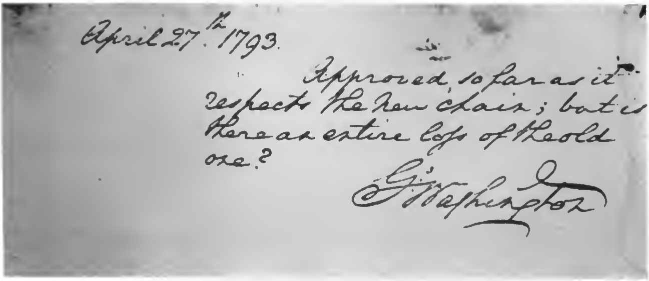
Note the overlapping of the arcs of visibility of lights on an important coast. The lights differ in character and thus may easily be distinguished

ago. She lived at Lime Rock lighthouse, on a ledge in Newport harbor, for 57 years, her father having been appointed keeper when she was 12 years old. She was keeper of the light for 32 years. There are reports of her having rescued 13 persons from drowning. On one occasion, it is said, she saved three men who had swamped while attempting to pick up a sheep, and then she rescued the sheep also.

Because of the difficult life, keepers at isolated stations are granted shore liberty and leave 72 days a year, and crews of light vessels 90 days a year.

THE BOSTON LIGHT WAS THE FIRST AMERICAN LIGHTHOUSE

The first lighthouse on this continent was built by the province of Massachusetts, in 1715-1716, on an island in the entrance to Boston harbor. In 1713 a



April 27th. 1793.

Approved, so far as it respects the new chain; but is there an entire loss of the old one?

G. Washington

AN ENDORSEMENT BY PRESIDENT WASHINGTON, IN HIS OWN HANDWRITING, ON A LIGHTHOUSE DOCUMENT

Showing the caution exercised by the first President in approving a contract for making a chain for a buoy (see page 10)

committee reported to the General Court on "the most convenient Place for Erecting a Light House, which will be of great Use not only for the Preservation of the Lives and Estates of Persons designing for the Harbour of Boston and Charlestown but of any other Place within the Massachusetts Bay," and the court resolved "that the Projection will be of general publick Benefit and Service and is worthy to be encouraged," and that the want of such a lighthouse "hath been a great Discouragement to Navigation by the loss of the lives and Estates of several of His Majesties Subjects."

In 1719 the keeper petitioned the General Court "that a great Gun be placed on Said Island to answer Ships in a Fog." The court voted the gun, and it was probably the earliest fog signal established in this country (see page 4).

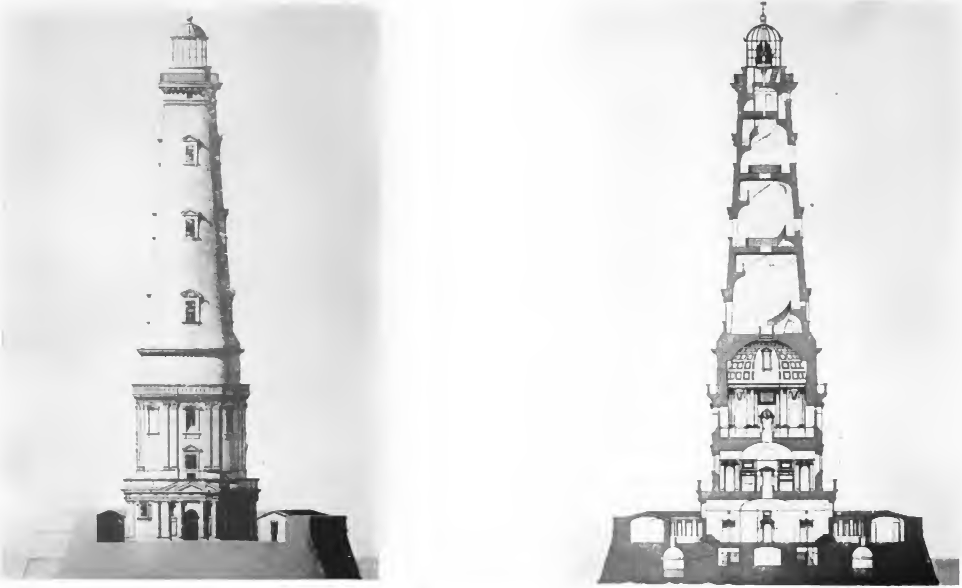
The light was supported by light dues of one penny per ton, levied by the receiver of impost at Boston on all incoming and outgoing vessels except coasters. This lighthouse was an object of attack during the early part of the Revolutionary War, and was burned by the Americans and finally blown up by the British in 1776. A new lighthouse on the same site was built in 1783 by Massachusetts, and this, with various alterations, is the present Boston light.

Although candles and even coal fires appear to have been used in lighthouse illumination in England to a much later date, Boston light was probably illuminated from the first by oil lamps. In 1789 the light was produced by 16 lamps in groups of 4. Crude lenses and reflectors were fitted in 1811, and also revolving mechanism, it having previously been a fixed light. In 1838 Boston light is described as "a revolving light, consisting of 14 Argand lamps, with parabolic reflectors," the lamps being "of about the volume of similar lamps in family use." In 1839 large reflectors 21 inches in diameter were fitted to this light. Boston light was provided with a Fresnel lens in 1859.

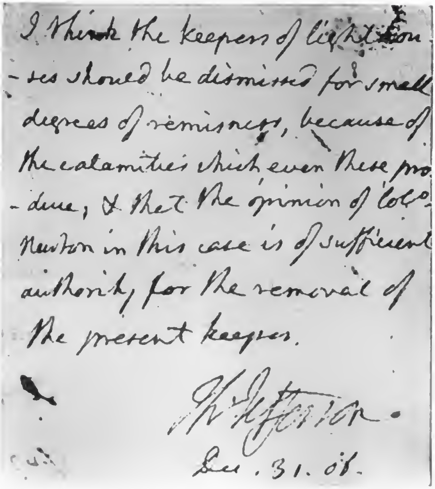
Apparently the gun was the only fog signal at this station until about 1852, when a fog-bell was installed. A mechanical striking bell was installed in 1869, in 1872 a fog trumpet, and in 1887 an air siren.

THE ESTABLISHMENT OF OUR LIGHTHOUSE SERVICE WAS ONE OF THE FIRST ACTS OF THE FEDERAL GOVERNMENT

Several other lighthouses were built and maintained by the colonial governments. On the organization of the national government, at the first session of Congress, an act was passed, approved on August 7, 1789, providing that all expenses "in the necessary support, maintenance and repairs of all lighthouses,



VIEW AND SECTION OF THE BEAUTIFUL LIGHTHOUSE ON THE COAST OF FRANCE, PHARE DE CORDOUAN, COMPLETED IN 1611 AND SINCE ALTERED: THE OLDEST SEA-SWEPT LIGHTHOUSE NOW IN EXISTENCE (SEE PAGE 17)



I think the keepers of lighthou-
-ses should be dismissed for small
degrees of remissness, because of
the calamities which even these pro-
-duce, & that the opinion of Colo.
Newton in this case is of sufficient
authority for the removal of
the present keeper.

Th: Jefferson
Dec. 31. 08.

AN ENDORSEMENT BY PRESIDENT JEFFERSON, IN HIS OWN HANDWRITING

Expressing his opinion of the responsibility of light-keepers (see page 15)

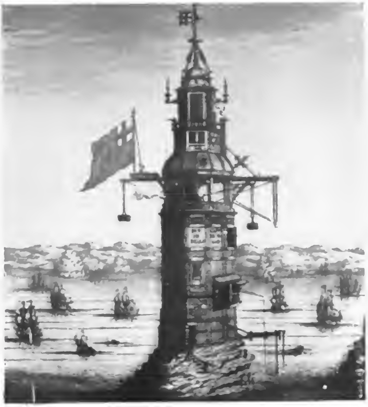
beacons, buoys and public piers erected, placed, or sunk before the passing of this act, at the entrance of, or within any bay, inlet, harbor, or port of the United States, for rendering the navigation thereof easy and safe, shall be defrayed out of the Treasury of the United States." Thus the Lighthouse Service was one of the earliest established by the Federal government, though it has been conducted under several different forms of administration.

The maintenance of lighthouses, buoys, and other navigational aids was, at the organization of the government, placed under the Treasury Department, and the details of lighthouse work were directed personally by the Secretary of the Treasury — Alexander Hamilton — by whom many of the earlier papers are signed. This work was during two later periods placed under the Commissioner of Revenue.

In 1820 the administration of the lighthouses devolved upon the Fifth Auditor of the Treasury, who was popularly known as the general superintendent of lights. Mr. Stephen Pleasonton discharged these duties for 32 years. In 1852 Congress established the United States Lighthouse Board, composed of three naval officers, three army engineers, and two civilians, with the Secretary of the Treasury as *ex-officio* President of the Board. The Chairmen of this Board were Admirals in the Navy, with the single exception of Prof. Joseph Henry, who was Chairman from 1871 to 1878. In 1910 the present Bureau of Lighthouses was established by Congress, under charge of a Commissioner of Lighthouses and other executive officers appointed by the President. The Lighthouse Service is now a part of the Department of Commerce and Labor, to which it was transferred from the Treasury in 1903.

Under the act of 1789, 13 lighthouses were ceded to the United States by the several States, though apparently but eight of these were in actual operation at the date of the act (these are the eight first named in the list). The following are the lighthouses ceded, most of which are standing at the present time, although much altered:

Portsmouth Harbor, N. H.
Boston, Mass.
Plymouth (Gurnet), Mass.
Brant Point, Nantucket Island, Mass.
Beavertail, Newport, R. I.
Sandy Hook, N. Y.
Cape Henlopen, Del.
Charleston, S. C.
Portland Head, Maine.
Newburyport Harbor, Plum Id., Mass.
Cape Ann, Thatcher Island, Mass.
New London Harbor, Conn.
Tybee, Ga.



THE FIRST EDDYSTONE LIGHT, OFF THE SOUTH COAST OF ENGLAND

The Eddystone is the most famous lighthouse in the world. Four towers have been built on this dangerous rock. This, the first one, of fantastic design, was completed in 1699 and destroyed in the great storm of November, 1703, and the keepers and the engineer who built it were lost (see page 17).

The oldest of the existing lighthouse structures in this country is the tower at Sandy Hook, New York, built in 1764. The lighthouse at Cape Henlopen, Delaware, was completed the same year. These are similar in design—massive structures of stone and brick, with walls 7 feet thick at the base (see page 5).

PERSONAL ATTENTION GIVEN BY PRESIDENT WASHINGTON TO LIGHTHOUSE MATTERS

Massachusetts, in ceding her lighthouses, showed her caution with respect to the new government by providing "that if the United States shall at any time hereafter neglect to keep lighted, and in repair, any one or more of the lighthouses aforesaid, that then the grant of such lighthouse or lighthouses so neglected shall be void and of no effect;" and also "that if the United States shall at any time hereafter make any compensation to any one of the United States for the cession of any lighthouse . . . like compensation be made to this Commonwealth by the United States, for the cession of the Light Houses aforesaid, in proportion to their respective values."

There are many interesting documents in the early archives of the service showing the attention given by high officers of the government to matters of lighthouse detail. President Washington personally approved such contracts as these: for the purchase of spermaceti oil for Cape Henry lighthouse, "to erect, sink, and build a well for water" for Cape Henlopen lighthouse, and for making "a mooring chain for one of the Floating Beacons of the Delaware Bay." On the last document appears the endorsement, all in Washington's handwriting, "April 27th, 1793. Approved, so far as it respects the new chain; but is there an entire loss of the old one? G°. Washington." There is a proposal for Tybee lighthouse "for a hanging stair case for the sume of £160," or "should a plain square stair case be preferred," for £110, with the endorsement, "Approved with the plain stair case. G°. Washington."

During the earlier administrations the salaries of lighthouse-keepers were fixed by the President, and appointments of keepers were approved by him. The following document is of interest as showing the salaries then paid:

"UNITED STATES, *July* 18*th*, 1793.

"By the President's command T. Lear has the honor to inform the Secretary of the Treasury, that the President having duly considered the Representation of the Commissioner of the Revenue and the other documents relative to the compensations of the Keepers of the Light Houses, which were put into his hands by the Secretary, approves of the alterations of certain compensations as suggested by the Secretary, viz:

"1st. For the Keeper of the Light Houses on Thatcher's Island per annum, 266 2/3 doll.

"2. do. Boston Bay, 266 2/3 doll.
"3. do. Plymouth, 200 doll.
"4. do. Portland Head, 160 doll.
"5. do. Conanicut, 160 doll.
"6. do. New London, 120 doll.
"7. do. Sandy Hook, 266 2/3 doll

"To commence from the 1st day of the present Month.—

"The President thinks it proper that the Keeper of the Light House at Portsmouth be informed, that he must reside on the spot where the Light House is, if he continues in that office, and that he will not be permitted to employ a deputy to take care of the Light House, unless upon some special occasion.

"TOBIAS LEAR,
"*Secretary to the President of the United States.*"

The Commissioner of the Revenue in 1797 writes to the Secretary of the Treasury regarding salaries of keepers: "In the case of Major ——, there are the advantages of plenty of fuel, without expense, upon the public land, the opportunity to fish for his family use, or even for sale, a boat to fish in will be furnished for passing to the main, there is a little land for tillage and grass, and for a plentiful garden. The place is represented to be very healthy. . . . I have been thus particular because the salaries of keepers appear to have been subjected to some miscalculation on their parts from the unnecessary degree of former standing, which some of the candidates have had. It is plain at first view, that the above duties are not in their nature adapted to the standing of a field officer, or of a Major of Brigade."

LANDING THE RELIEF AT THE EDDYSTONE

The keepers in turn are allowed shore liberty. It is often difficult to land at a wave-swept lighthouse

A recommendation of a person for appointment as keeper in 1809 stated that the applicant "being by occupation a mason will engage to keep the Light House white washed, should he receive the appointment, free from any expense to the Government as long as he is its Keeper."

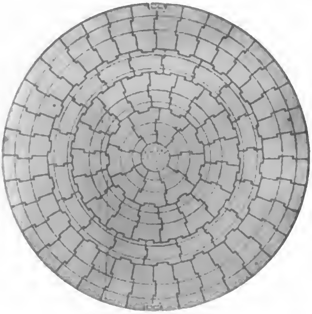
THE PETITIONS OF EBENEZER SKIFF, KEEPER OF GAY HEAD LIGHTHOUSE

The keeper of Gayhead lighthouse in 1805 made this petition for an increase of salary:

"Gayhead, October 25, 1805.

"SIR: Clay and Oker of different colours from which this place derived its name ascend in a Sheet of wind pened by the high Clifts and catch on the light House Glass, which often requires cleaning on the outside—tedious service in cold weather, and additional to what is necessary in any other part of the Massachusetts.

THE FOURTH AND PRESENT EDDYSTONE LIGHTHOUSE, COMPLETED IN 1881 (SEE PAGE 17)



A SECTION OF THE BASE OF THE EDDYSTONE TOWER

Showing how the stones are dovetailed so as to withstand the terrible buffeting of the sea

"The Spring of water in the edge of the Clift is not sufficient. I have carted almost the whole of the water used in my family during the last Summer and until this Month commenced, from nearly one mile distant.

"These Impediments were neither known nor under Consideration at the time of fixing my Salary.

"I humbly pray you to think of me, and (if it shall be consistent with your wisdom) increase my Salary.

"And in duty bound I am your's to Command

"EBENEZER SKIFF,
Keeper of Gayhead Light House.

"ALBERT GALLATIN ESQUIRE
"Secretary of the Treasury."

In consequence of this letter President Jefferson approved of increasing his salary by $50 to $250 per annum.

Ten years later the same Ebenezer Skiff petitions for an increase of salary on these grounds, some of which have a familiar ring, although the spelling has somewhat changed. The letter is quoted in full, as of interest in showing the life of a light-keeper at that date:

"To Samuel Smith Esquire Commissioner of the Revenue

"SIR: Clay ochre and earth of various colours from which this place derived its name ascend in a sheet of wind from the high clifts and catch on the glass of the light-house, which glass requires to be often cleaned on the outside:—Tedious service in cold weather and not so commonly necessary in any other place in the Massachusetts, nor in any of the New England States.

"The Spring of water in the edge of the clifts, by means of their late caving has become useless. I cart the water used in my family more than half a mile, necessarily keep a draught horse and carriage for that purpose and frequently have to travel in a hilly common extending five miles to find the horse. Truely I catch some rainwater and it is as true that many times I empty it coloured as red as blood with oker blown from the clifts.

"My firewood is brought from the Mainland and, there being neither harbor nor wharf here, is more expensive than in seaports. Keepers in some places get their wood with little cost; but here the native Indians watch the shores to take all drifts.

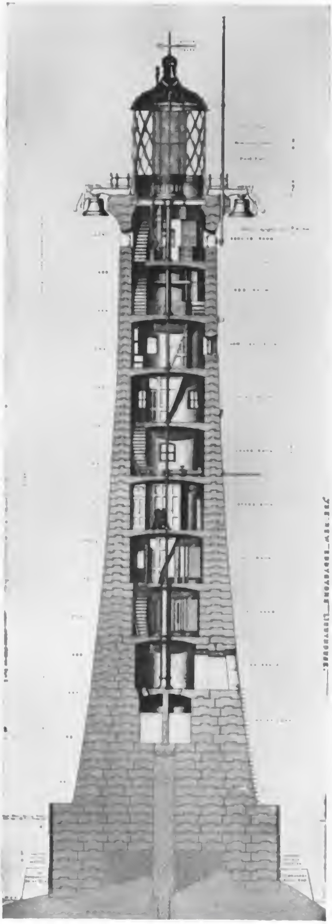
"The lately constructed light with a stone revolves by a clock which is to be stopped every time anything is done to the fire, which, in cold weather, must be kindled the sun an hour high, or sooner, and recruited until eleven o'clock, or after, when I have to trim the lamps and wind up the weights of the clock and can go into bed at nearly midnight until which a fire is kept in the dwelling-house consuming more wood than when I tended the former light.

"It is about eight miles from here to a gristmill and in the common way of passing are creeks not fordable at all seasons.

"The business respecting the light is, mostly, done by me in person, yet I occasionally leave home to procure wood and many other necessaries; previous to which I have to agree with and instruct some trusty white person to tend the light in my absence: If my salary would admit I would hire some person to live constantly with me lest I should be sick—I have no neighbors here but Indians or people of colour.

"Tending the former light might be deemed a simple business if compar'd with the tendance of the present complicated works and machinery, which requires much time care &c.

"Almost any man or lad under my wife's care could light the former lamp



A SKETCH OF THE INTERIOR OF THE EDDYSTONE LIGHTHOUSE

Showing the foundation, dovetailing of stones, and interior arrangement

PRESENT STONE LIGHTHOUSE ON MINOTS LEDGE, MASSACHUSETTS: NOTE THE BREAKING SURF

This structure ranks among the difficult lighthouse engineering works of the world. During the first summer only 130 working hours were obtained on the rock, and after three years' work only four stones of the foundation had been laid. Commenced in 1855 and completed in 1860 (see page 18).

and do the business a short time; but the case is not so now.

"When I hire an Indian to work I usually give him a dollar per day when the days are long and seventy five cents a day when the days are short and give him three meals: Now supposing the meals worth twenty-five cents each they amount to seventy five cents which is seven cents more than the wages for my service both a day and night (while I board myself) only sixty eight cents, computing my Salary (as it now is) at two hundred and fifty dollars a year and the year to consist of three hundred and sixty five days.

"I have the use of two acres of land intersected with buildings, the use of a small dwellinghouse and a small barn.

"I refer you to Capt. Winslow Lewis Superintendent of the Lamps &c. for the truth respecting all of the above particulars that he is acquainted with—and before I forward this Application shall lay before the Selectmen of Chilmark, which adjoins Gay Head, for their inspection: And in duty bound I humbly pray you to take this Matter into your wise consideration and afford me relief by granting an increase to my Salary.

"Gay Head 2nd November 1815.

"I am Sir with all possible respect yours to command.

"EBENEZER SKIFF."

As a result of this letter, President Madison approved of a further increase of $50 in his salary.

CHARACTERISTIC ENDORSEMENTS BY JEFFERSON

On a recommendation to appoint Jared Hand as keeper of Montauk Point light

STANNARD ROCK LIGHT, MICHIGAN

Built in 11 feet of water, 24 miles from the nearest land, it marks the most dangerous reef in Lake Superior. It is the most distant from shore of any lighthouse of this country.

to succeed his father, President Jefferson wrote this endorsement:

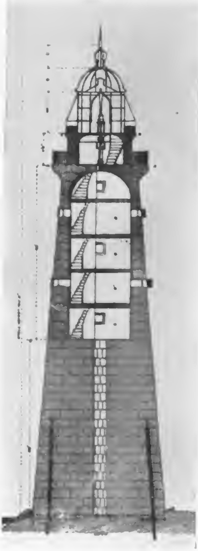
"I have constantly refused to give in to this method of making offices hereditary. Whenever this one becomes actually vacant, the claims of Jared Hand may be considered with those of other competitors. "THOMAS JEFFERSON."

In a matter respecting the conduct of the keeper of Cape Henry lighthouse he wrote:

"I think the keepers of light houses should be dismissed for small degrees of remissness, because of the calamities which even these produce; and that the opinion of Col. Newton in this case is of sufficient authority for the removal of the present keeper.

"Dec. 31, '06." "TH. JEFFERSON.

LOCATION AND CONSTRUCTION OF LIGHTHOUSES



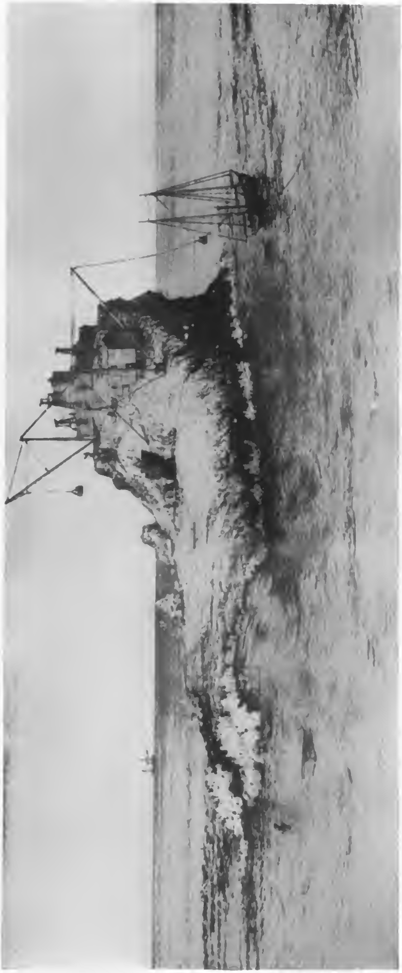
SECTION OF MINOTS LEDGE LIGHTHOUSE

Showing fastening of stones and interior arrangement. It is 107 feet from base to summit.

The first-class light and fog-signal stations are located at the more prominent and dangerous points along the seaboard, and on a well-lighted coast such stations should be sufficiently close that a coasting vessel may always be in sight of a light. The smaller lights are placed to mark harbors, inside channels, and dangers. Along the navigable rivers numerous post lights are maintained to indicate the channels.

For New York harbor and immediate approaches alone 268 aids to navigation are required, including 46 shore lights, 2 light vessels, and 36 lighted buoys; there are 192 buoys of all classes and 37 fog signals, including sounding buoys.

A chart of New York harbor in 1737 shows not a single aid to navigation there at that time. One may imagine the difficulties of Henry Hudson when in 1609 he sailed into New York Bay in the *Halfmoon*. The diary says: "We found



BUILDING THE TILLAMOOK ROCK LIGHT STATION, OREGON

Open to the sweep of the Pacific Ocean and one of the most exposed stations in the world; completed in 1881 (see page 21)

it ' to have a very shoald barre before it;" and, again, "the mouth of that land hath many shoalds." Boats were repeatedly sent ahead to sound as the *Halfmoon* worked her way into the harbor and river.

The natural alterations in channels and coast lines, the progress of improvements, and the changes in the trend and character of commerce and shipping make numerous modifications necessary in the aids to navigation, so that this is a work that will never be complete while nature and man are active. During the past year notices have been published of about 1,600 distinct changes in aids to navigation maintained by the United States Lighthouse Service.

Among the lighthouses of the country may be found examples of great engineering skill and of dignified and simple design. Some of the tall lighthouse structures are of beautiful architecture, suited to the purpose, and set off by picturesque location on headland or rock overlooking the sea. The tower must be built to give the light a suitable height above the water, and hence tall lighthouses are required on low-lying coasts.

A light must be about 200 feet above the water to be seen from the deck of a

THE TILLAMOOK ROCK LIGHT COMPLETED

The seas here are terrific. On October 19, 1912, a wave broke a pane of the lantern 132 feet above the sea (see page 21)

vessel 20 nautical miles distant; beyond that distance the curvature of the earth would prevent a light at this elevation being seen. The light and lens are protected by an outer lantern of glass.

At the principal stations provision is made either in the tower or in separate buildings for the mechanical equipment connected with light and fog signal, for storage of oil and supplies, for quarters for keepers and their families, boats, etc.

Various materials have been employed in lighthouse construction—stone, brick, iron, steel, concrete, reinforced concrete, and wood; in new work, however, the latter is now little used because of the desirability of permanency.

The Lighthouse Service at present owns 1,186 distinct pieces of land; besides this, many lights stand in the water, and post lights along the rivers are on temporary sites not purchased.

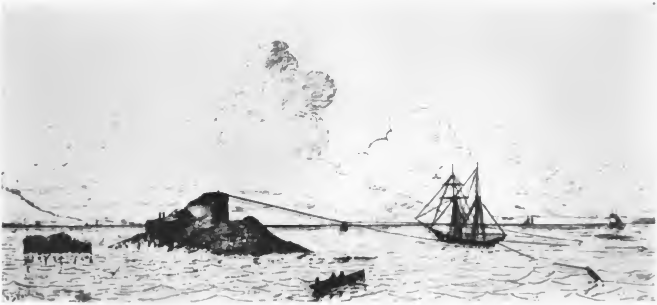
WONDERFUL SEA-SWEPT LIGHTHOUSES

Lighthouse construction on the land is usually comparatively simple, except when there is difficulty of access to the site. But often it is important for the protection of shipping that lighthouses be erected either on rocks or reefs exposed to the sea or actually in the water, on sand or rock bottom. Such work has called forth the greatest skill of engineers.

Numerous types of construction have been used. Where the foundation is exposed, even at the lowest tides, masonry towers have been, with great labor and often danger, fitted to the bed-rock; otherwise the structure has been erected on iron piles driven, screwed, or pumped into the sand or coral, or on caissons floated to the site and set on the bottom or sunk deeper by the pneumatic process, or by the use of coffer-dams, within which the masonry tower has been erected; smaller structures have been placed on rip-rap foundations.

The earliest example now existing of a sea-swept lighthouse is the beautiful tower of Cordouan, built in 1584 to 1611, on a rock in the sea at the mouth of the Gironde, on the west coast of France. This lighthouse has since been altered and raised in height. The original structure was elaborately decorated, and one floor was occupied by a chapel (see page 8).

The most famous of the sea-swept lighthouses is the Eddystone, 13 miles from Plymouth harbor, England. This was completed in 1699, after four years of work. During the first year all that was accomplished was drilling 12 holes in the rock and fastening irons in them. This lighthouse, with the keepers and the engineer who built it, disappeared in the great storm of November, 1703, and since



BUILDING THE LIGHTHOUSE ON ST. GEORGE REEF, CALIFORNIA

The rock is so exposed that the workmen were obliged to live in the schooner, moored beside the rock, and were carried back and forth by a traveler on a cable (see page 23)

ST. GEORGE REEF LIGHT, CALIFORNIA, COMPLETED: A DIFFICULT AND EXPENSIVE STRUCTURE

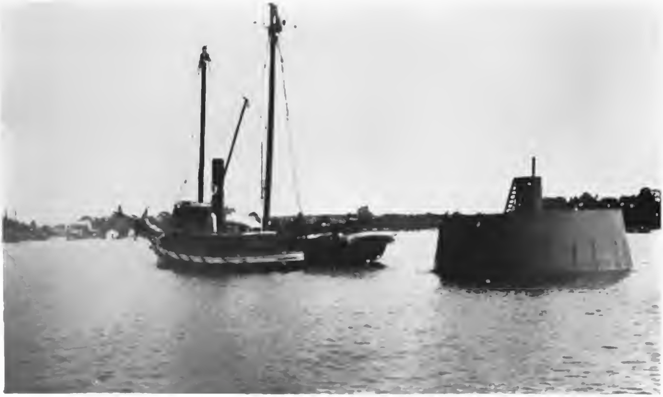
that time three other lighthouses have in succession been erected on the Eddystone (see pages 12-13).

MINOTS LEDGE LIGHT

The earliest lighthouse built in this country in a dangerous position, exposed to the open ocean, was that on Minots Ledge, a reef off Boston harbor which had long been a terror to mariners. This was an open-work iron-frame structure, supported on wrought-iron piles wedged into holes 5 feet deep, drilled in the rock, which was bare only at low water. It was completed in 1848 (see page 14).

There was a great gale in April, 1851. "The light on the Minot was last seen from Cohasset on Wednesday night at 10 o'clock. At 1 o'clock Thursday morning, the 17th, the light-house bell was heard on shore, one and one-half miles distant; and this being the hour of high water, or rather the turn of the tide, when from the opposition of the wind and the tide it is supposed that the sea was at its very highest mark; and it was at that hour, it is generally believed, that the light-house was destroyed; at daylight nothing of it was visible from shore, and hence it is most probable it was overthrown at or about the hour named." Two keepers were in the tower and were lost, and this extract from the official report tells the story of one of the great lighthouse tragedies.

The present massive stone lighthouse was built on the same site on Minots Ledge, commenced in 1855 and completed in 1860. It ranks among the difficult lighthouse engineering works of the world. During the first summer only 130 working hours were obtained on the rock, and after three years' work only four stones of the foundation were laid. The reef rock was prepared to fit the stones of the lower courses and the latter were



A TUG TOWING A CAISSON TO BE SUNK FOR A LIGHTHOUSE FOUNDATION (SEE PAGES 20 AND 26)

cut to interlock. Dwellings for the keepers' families were built on the shore, accommodations for the men only being provided in the tower.

Longfellow visited Minots light in 1871, and in a letter thus describes it: "The lighthouse rises out of the sea like a beautiful stone cannon, mouth upward, belching forth only friendly fires."

SPECTACLE REEF AND STANNARD ROCK

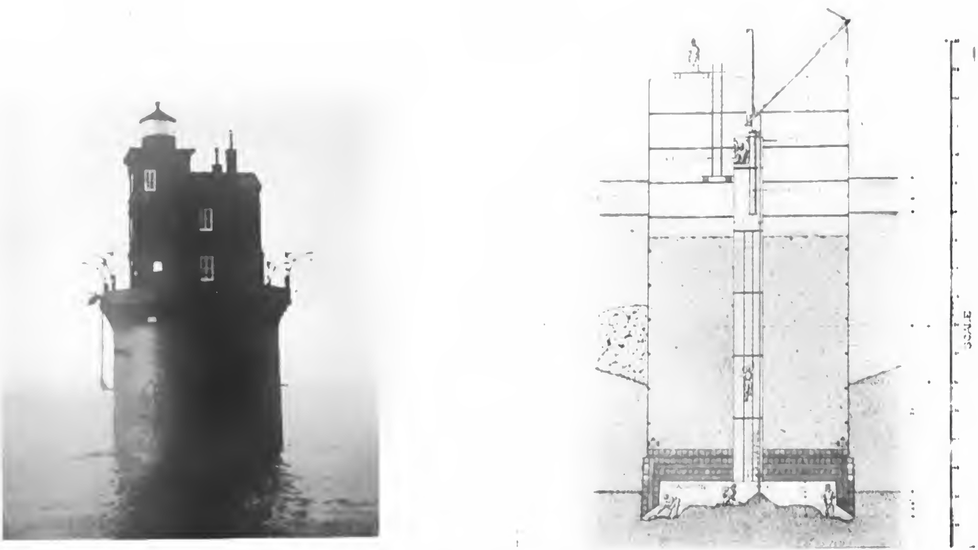
Spectacle Reef lighthouse, built on a reef near the northern end of Lake Huron, is a stone tower standing in a depth of 11 feet of water, 10 statute miles from land. It is in a position exposed to heavy ice action. A coffer-dam was constructed at the site, the water was pumped out, the bed-rock was leveled off, and the lighthouse was constructed of cut stone, securely fastened. It was completed in 1874, and is a notable engineering work. The first year it was well tested by the ice. When the keepers returned to the tower in the spring of 1875 they found the ice piled against it to a height of 30 feet. As this was 7 feet above the doorway, they had to cut through the ice to enter.

Stannard Rock light, 24 statute miles from the nearest land and marking the most dangerous reef in Lake Superior, is the most distant from shore of any lighthouse in this country. It was completed in 1882, constructed in a manner similar to that on Spectacle Reef, and stands in the same depth of water—11 feet (see page 15).

WHITE SHOAL LIGHT

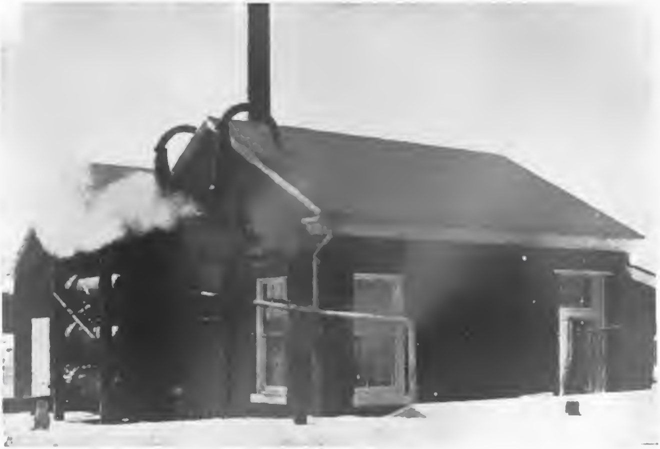
White Shoal, a dangerous spot in Lake Michigan, at the entrance to the Straits of Mackinac, was marked for 19 years by a light vessel anchored over it. On account of the ice, this vessel could not be kept on the station during a portion of the season of navigation in the spring and fall. As the unmarked shoal was a serious menace to navigation at these seasons, an appropriation was made for building a lighthouse, and this was completed in 1911 at a cost of $225,000.

A timber crib 72 feet square and 18 feet high was built on shore and floated out to the site, where the depth of water was 22 feet. The bottom, which is of coarse gravel, was covered with 2 feet of rock, and the crib was filled with stone and sunk. Above this was built a concrete pier, which supports the lighthouse.



THE 14-FOOT BANK LIGHTHOUSE, DELAWARE

The first lighthouse in this country, the foundation of which was placed by pneumatic process. Completed in 1887. The diagram shows men working in the caisson under air pressure removing the sand, which is blown out (see page 26)



CAPE HENRY FOG SIGNAL, VIRGINIA

This fog signal is an air siren driven by oil engines. The trumpets are curved downward to prevent sand drifting into the sirens. "The fog signals now in use in the United States consist of sirens, whistles, reed trumpets, aerial bells, and submarine bells. Sirens and whistles are operated by compressed air or steam, and trumpets by compressed air. To furnish air, compressors driven by internal combustion engines are used, and for steam signal boilers are employed. The larger fog bells, up to 4,000 pounds, have hammers actuated by a weight and clockwork" (see page 47).

The light is of 1,200,000 candle power, flashing white every 8 seconds. In addition to the compressed air fog-whistle there is a submarine bell signal, located in 60 feet of water three-quarters of a mile from the station. This bell is supported on a tripod standing on the bottom of the lake, is operated by electric power transmitted through a cable from the light station, and strikes "23."

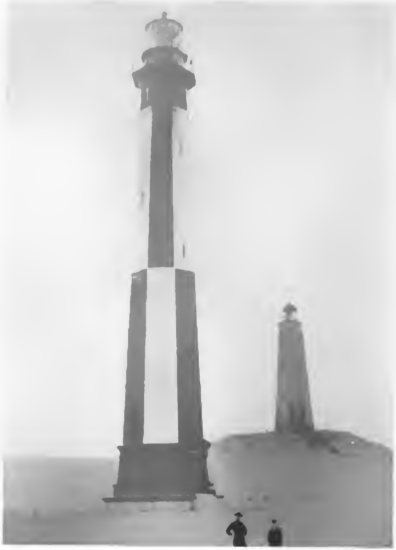
TILLAMOOK ROCK—ONE OF THE MOST EXPOSED IN THE WORLD

Two lighthouses involving great difficulties have been built on rocky islets off the Pacific coast—Tillamook Rock, completed in 1881, and St. George Reef in 1891. Tillamook is a high, precipitous rock south of the Columbia River and about a mile from shore. It is exposed to the sweep of the Pacific Ocean. Landing on the rock was very dangerous, and the foreman was drowned the first day a working party was landed. There was serious difficulty in providing any protection on the rock for the workmen. It was necessary to blast off the top of the rock to secure sufficient room for the lighthouse (see pages 16-17).

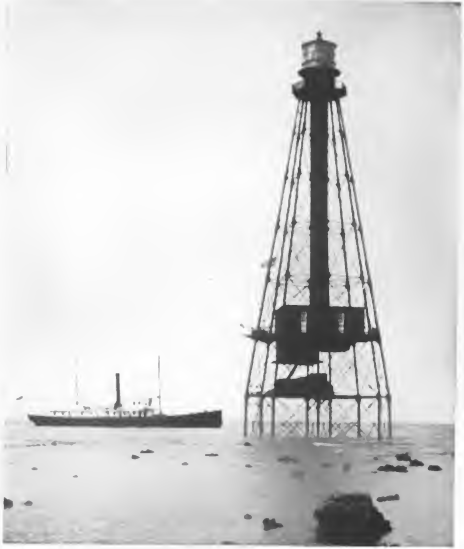
This light station is one of the most exposed in the world. The tower is 136 feet above high water, but the keepers reported that in a storm in 1887 the seas broke over the building, some going above the tower, and serious damage was done. In another storm *a mass of concrete "filling weighing half a ton was thrown over the fence into the enclosure," at a level of 88 feet above the sea.*

Here is the keeper's report of a storm in October, 1912, at Tillamook light. The lighthouse tender, on account of weather conditions, was not able to reach the rock for 7 weeks after this storm:

"I regret to state that on the evening of the 18th, or morning of the 19th, we lost a portion of the west end of the Rock, water and rocks coming over with so much noise we could not tell when, and did not know it had departed before

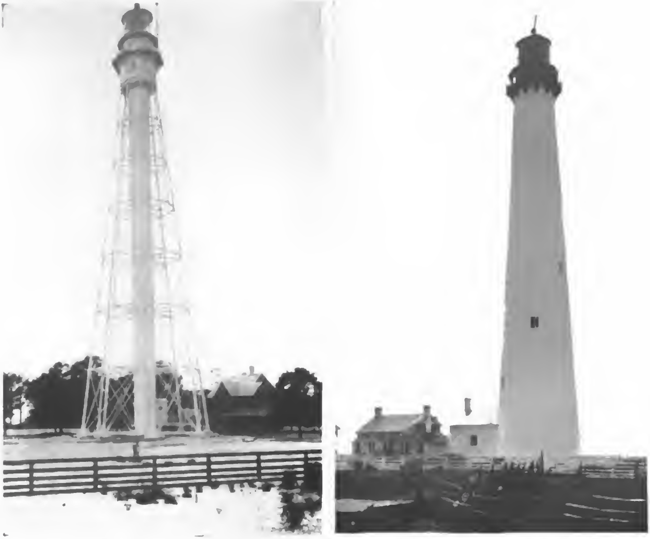


THE PRESENT LIGHTHOUSE AND THE OLD ABANDONED LIGHTHOUSE AT CAPE HENRY, VIRGINIA
(SEE PAGE 27)



SOMBRERO KEY LIGHT, FLORIDA

A pyramidal iron skeleton tower, supported on iron piles driven into the coral reef. The keepers live in the house (see page 25)



THE OLD AND THE NEW LIGHT TOWERS AT CAPE CHARLES, VIRGINIA

The tower on the right was built in 1864, but was abandoned in 1895, as the site was destroyed by erosion of the sea. The previous tower, built in 1827, had been discontinued in 1863 for the same reason. The new tower, shown on the left, consists of an iron cylinder surrounded by iron framework (see page 28).

next morning when the sea went down so that we could go outside.

"At 12:35 a. m. on the 19th the sea came up and broke one pane in of the middle section of the lantern (132 feet above the sea), which also put the light out and flooded the watch-room, as well as down-stairs. To add to it all the soot and ashes came out of the stove in the kitchen.

"At 12:50 a. m. we had the light burning and storm pane in for the rest of the night.

"Siren was running until the crash came, but making no regular blast on account of the water filling the trumpet too fast. After getting the light burning we closed down the fog signal, as the wind hauled to westward and cleared the atmosphere somewhat. Shortly afterward when taking siren out to clear it I found it filled partly full with rocks; therefore the water could not get out of it (siren horns are 95 feet above the sea).

"Will also state that every one under my charge worked hard and faithfully, regardless of water and glass, everybody being drenched to the skin."

Before the location of the lighthouse, this rock had been a favorite resort of sea lions, who completely covered its slopes; these at first were hostile and disposed to object to other use of the rock, but finally retired to other resorts.

ST. GEORGE REEF LIGHT, CALIFORNIA

St. George Reef light is built on a rock lying 6 miles off the northern coast of California. The rock was so exposed and swept by the seas that workmen could not safely live upon it, and it was necessary to moor a schooner near the rock to provide quarters for the men, who were transported back and forth by

THE PETIT MANAN LIGHTHOUSE, MAINE

A granite tower, 115 feet high. The light is white, fixed and flashing, showing a steady light for 1 minute, and a 5-second flash in the next minute. The fog signal is a steam whistle giving each minute two blasts of 5 seconds each.

THE ST. JOHNS RIVER LIGHT, FLORIDA

A brick lighthouse at the entrance to St. Johns River. A fixed white light, without fog signal. This light was recently changed from an oil wick lamp to an incandescent oil vapor lamp, increasing the candle power from 860 to 13,000.

THE PIGEON POINT LIGHTHOUSE, ON THE RUGGED PACIFIC COAST, CALIFORNIA

This light gives each 10 seconds a flash of 4 seconds' duration and 160,000 candle power. The fog signal is a first-class air siren, giving each 30 seconds two blasts in quick succession

a traveler on a cable. The total cost of the work at St. George Reef was about $712,000, making it the most expensive lighthouse that has been built in this country. These two exposed light stations on the Pacific coast are the only ones having five keepers (see pp. 16-18).

Of lighthouses built on piles in the water, the original Minots Ledge structure has been mentioned. Brandywine Shoal light, in 6 feet of water in Delaware Bay, completed in 1850, was the first in the United States built on iron screw-piles. These were bored down 6 feet into the sand bottom, the broad screws at the ends of the piles also furnishing additional bearing surface: this structure has stood 62 years, but now must be rebuilt on account of the piles having been damaged by the ice.

LIGHTS ON THE FLORIDA REEFS

Five pyramidal iron skeleton lighthouses have been built in the water along the Florida reefs: these are supported on iron piles forced about 10 feet into the coral rock or sand. The piles are driven through large cast-iron discs, with a shoulder bearing on the disc; these discs are about 8 feet in diameter and give a broad support for the structure.

Sombrero Key, with its light 142 feet above the sea, is the tallest of these reef lighthouses (see page 22). The keepers' quarters are carried within the skeleton tower, and they thus live 37 feet above the water.

LIGHTS ON SAND BOTTOM—THE 14-FOOT BANK LIGHT

The first lighthouse built in the sea distant from the land and not on a rock foundation was the Rothersand. This notable engineering work stands in 20 feet of water, on a sand foundation, in the North Sea, 10 miles from the German coast, in the approach to Bremen. The first attempt to place a lighthouse in this position resulted in failure, but a structure was finally completed in 1885.

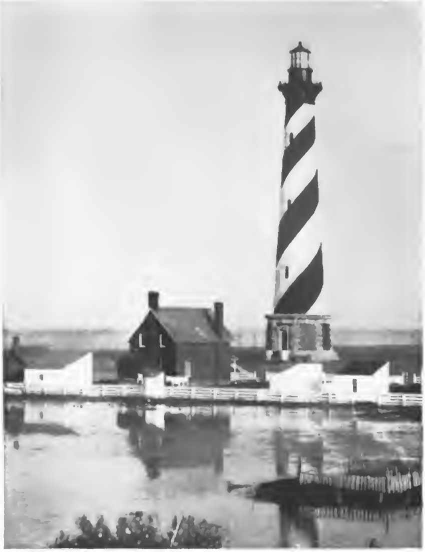
A POST LIGHT ON THE MISSISSIPPI RIVER

Post lights are maintained on about 5,500 miles of rivers in the United States

A caisson of boiler iron 36 feet wide, 46 feet long, and 61 feet deep was built in port. This caisson was towed to the site and sunk in position. Eight feet above the lower or cutting edge of the caisson was a diaphragm, forming a working chamber, from the center of which rose a cylindrical shaft with an airlock. The caisson was sunk by the pneumatic process to a depth of 73 feet below low water, the sand being removed from the working chamber by a sand blast; the caisson was filled with concrete and masonry and the light-tower erected on this foundation.

Two years later, in 1887, the first lighthouse in the United States built on a submarine foundation and sunk in a sand bottom by the pneumatic process was completed on Fourteen-foot Bank, Delaware Bay, in 20 feet of water. A timber working chamber 40 feet square was built, with cutting edge 7 feet deep. On this was placed an iron cylinder 35 feet in diameter and 18 feet high, built of cast-iron plates bolted together by their flanges. This was towed to the site and placed in position. It was sunk, by digging and blowing out the sand, to a depth of 33 feet below the surface of the shoal, the cylinder being built up until it was 73 feet high and filled in with concrete (see page 20).

Cast-iron cylinders have been used also on other shallow submarine sites affording stable foundations or on rocks nearly awash. Wooden cribs floated to the site have been similarly employed, an example of which is Detroit River lighthouse. Recently reinforced concrete caissons have been used, sunk in place on the bottom, for minor light stations.



THE TALLEST LIGHT TOWER OF THIS COUNTRY, 200 FEET HIGH: THE CAPE HATTERAS LIGHTHOUSE, NORTH CAROLINA

The spiral painting is to furnish a distinctive day-mark to mariners. "A light must be about 200 feet above the water to be seen from the deck of a vessel 20 nautical miles distant; beyond that distance the curvature of the earth would prevent a light at this elevation being seen."

FAMOUS SHORE LIGHTS

Cape Henry lighthouse, at the entrance to Chesapeake Bay, is an example of an iron tower built with cast-iron plates bolted together along their flanges. The old tower at Cape Henry, abandoned in 1881, was the first lighthouse built by the United States government, being completed in 1791. There is a letter dated December 18, 1789, from Governor Randolph of Virginia to President Washington, saying: "The State some years ago placed upon the shore at Cape Henry nearly a sufficient quantity of materials to complete such a lighthouse as was at that time thought convenient, which have been in the course of time covered by sand. Measures are taking to extricate them from this situation," and offering to sell the materials and cede the necessary land to the United States (see page 22).

Petit Manan lighthouse, Maine, is a granite tower 115 feet in height. On Thatcher Island, at Cape Ann, Massachusetts, are two handsome granite light-towers, each 124 feet in height. St. Johns River light, Florida, is of brick, 80 feet high (see page 24).

The tallest light-tower in the United States is that at Cape Hatteras, on the low-lying coast of North Carolina, which is 200 feet from base to top of lantern. The highest light, however, is that at Cape Mendocino, on the coast of California, which is shown 422 feet above high water; it is on a cliff, the lighthouse itself being only 20 feet in height (see pages 27 and 29).

The main channel range for the harbor of Charleston, South Carolina, is com-

THE TWIN LIGHTS OF CAPE ANN, MASSACHUSETTS

Two granite towers, originally built in 1789. The two fixed lights were established to furnish a distinctive aid, a purpose which now would be attained by a single flashing light (see pages 27 and 37)

posed of two stations of historic interest, the front-range light being on Fort Sumter and the rear light in the beautiful spire of St. Philips Church (see page 30).

LIGHTHOUSE DISASTERS AND PERILS

Many are the vicissitudes and tragedies that are connected with lighthouse history. Mention has been made of the destruction by storm of the first Eddystone and the first Minots Ledge lights, with the loss of all the keepers, and of the fact that the first Boston light was burned and finally blown up, incident to the operations of war (see pages 4 and 7).

The danger of fire is great. There is a quaint report by Jesse Tay, inspector of customs, of the burning on November 7, 1792, of Tybee lighthouse, the first built in Georgia: "About 2 o'clock in the morning the negro that trimed the lites went up to trim them and he discovered the lanthorn in flames he cry'd out the litehouse was on fier i jump'd up and run up Stairs . . . the glass and sinders was fawling so thick and it was so very hot i was not able to tarry half a moment and i saw it was in vain to attempt to save it."

Lighthouses are sometimes undermined by the encroachment of the sea. From this cause three successive towers have been built at Cape Charles, Virginia. The first was constructed in 1827, 700 feet from the then shoreline; this was abandoned in 1863, and the whole site has now been washed into the sea.

The second was built in 1864, also about 700 feet from the shore, but the sea continued to encroach until this now stands on the edge of the water.

The present lighthouse was built in 1895, about 3,600 feet from the shore, and is an iron cylinder 9 feet in diameter, surrounded and braced by an iron framework. This light flashes "45" every minute, four flashes in succession, followed by an eclipse, and then five flashes (see page 23).

Hunting Island lighthouse is a tower of cast-iron plates, built in 1859, about a quarter of a mile from the sea, on the coast of South Carolina. On account of the sea cutting away the end of the island, its position became unsafe, and in 1889 the lighthouse was taken down and reerected on a new site 1¼ miles distant.

Sand Island lighthouse, with keepers' dwelling, was built on a sand island at the entrance to Mobile Bay, Alabama. The hurricane of September, 1906, carried disaster along the Gulf coast, and this telegram was received from the lighthouse inspector: "Sand Island light out, island washed away, dwelling gone, keepers not to be found." The tower remained, and one keeper had, fortunately, gone ashore, but the other keeper and his wife perished (see page 32).

Point Arena lighthouse, California, was wrecked by the great earthquake of April, 1906; it has been replaced by the first light-tower of reinforced concrete built in this country.

THE CAPE MENDOCINO LIGHT, CALIFORNIA

This lighthouse is only 20 feet in height, but it stands on the edge of a cliff, and the light is 422 feet above the sea, the most elevated in this country.

The foundation of Chandeleur light, on the coast of Louisiana, was undermined and the tower thrown out of plumb by a storm in October, 1893.

Thimble Shoal lighthouse, in Chesapeake Bay, was run into by a schooner recently, the structure broken, and the house and light destroyed by the fire which resulted. This is the second time the structure has been destroyed by fire, and it has been rammed a number of times by vessels and tows (see page 33).

TROUBLES FROM ICE, BIRDS, AND SAND

Winter seriously increases the work of maintaining aids to navigation; the spray or sleet freezing may completely envelop the tower in ice, obscuring the light until the lantern is cleared. In northern waters, where there is floating ice, many of the gas buoys must be removed in winter and replaced by spar buoys, over which the ice may pass without serious damage to the buoy. The spray freezes to bell buoys sometimes until the weight of the ice overturns them.

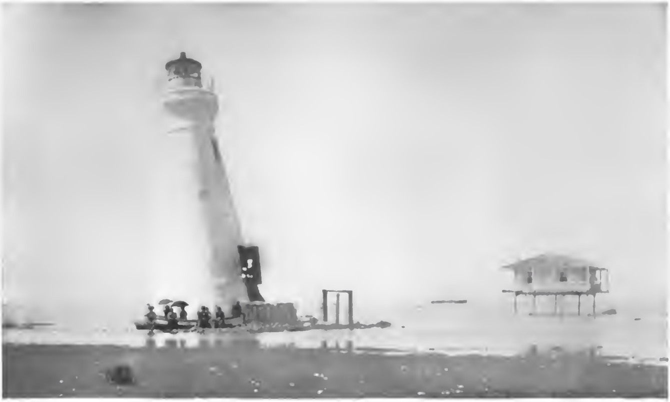
Most of the lighthouses on the Great Lakes are closed during the winter months, when general navigation ceases on those waters. There is risk to men and vessels in taking off the keepers in the winter gales at the close of navigation. In 1893 three lighthouses in Chesapeake Bay—Wolf Trap, Smiths Point, and Solomons Lamp—were swept away by the ice.

Sand creates difficulties at some light stations located among dunes or shifting wastes of sand. At Cape Henlopen the sand driven by the wind has cut deeply into the wood framing of the keepers' dwellings, and has ground the window glass so that it is no longer transparent: but the lantern of the light is too high to be so affected.

Even the flying birds make trouble at

THE RANGE LIGHTS FOR CHARLESTON HARBOR, SOUTH CAROLINA

These two lights in line form a range for entering Charleston Harbor. Both are of historic interest—the front light on Fort Sumter and the rear light in the beautiful spire of St. Philips Church



THE CHANDELEUR LIGHT-TOWER, LOUISIANA, WHICH WAS ABANDONED AFTER BEING UNDERMINED BY A TORNADO IN 1893

lighthouses, as the brilliant light so attracts them that they will fly directly for it, and striking the heavy glass of the lantern are killed and fall to the ground. At Cape Charles light the keeper has seen ducks fly directly through the lantern and fall to the floor cut and torn by the broken glass. Some lighthouses are fitted with bird-protecting screens around the lantern, as for instance at Mayo Beach light on Cape Cod. When Sabine Bank light, in the Gulf of Mexico, was increased in brilliancy by installing an oil vapor lamp, a bird-guard was found necessary because of the birds flying for the lantern, attracted by the more brilliant light.

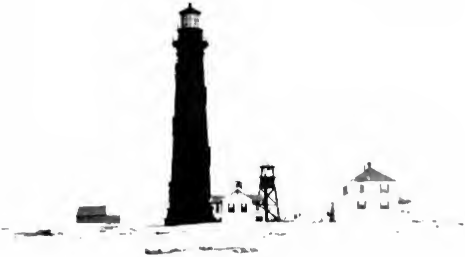
FROM WOOD FIRES AND CANDLES TO OIL VAPOR AND ELECTRIC LAMPS

The early lighthouses were lighted by wood or coal fires burned in open braziers, and later by candles inclosed in lanterns; the resulting light was necessarily weak and fitful, and a large part was lost by being diffused in directions of no use to mariners. A coal fire was burned at the Isle of May light on the coast of Scotland up to 1816, and the famous Eddystone was lighted with 24 wax candles to 1811. Oil lamps were early used in this country, if not from the first lighting of Boston light. Fish oil, sperm oil, colza oil, lard oil, and mineral oil were in turn burned, increasing expense in each case compelling a change. Circular wick lamps, with a central current of air, were invented by Argand in 1782.

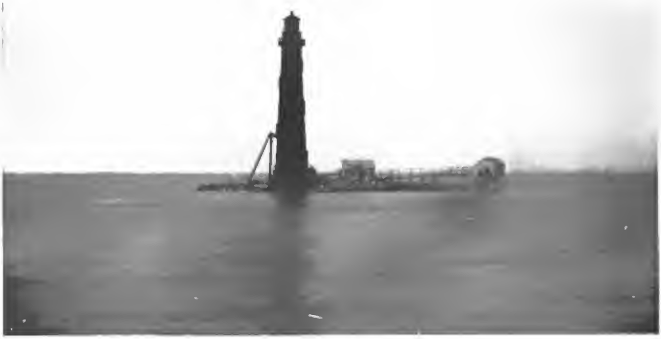
At the present time lamps with from one to five concentric wicks, and burning a high grade of kerosene oil, are used in a majority of lighthouses. About 610,000 gallons of oil are burned each year at the light stations of the United States, about 340,000 gallons of which are for lighthouse illumination.

For the more important lights the incandescent oil vapor lamp is now used, having been introduced by the French in 1898. In this lamp the oil is heated and then vaporized, and is burned mixed with air under a mantle which is made incandescent. This gives a much more brilliant light than the wick lamp, with a smaller consumption of oil.

For instance, this change of lamps recently made at Cape Hatteras light has increased the brilliancy of the light from 34,000 to 160,000 candle power,



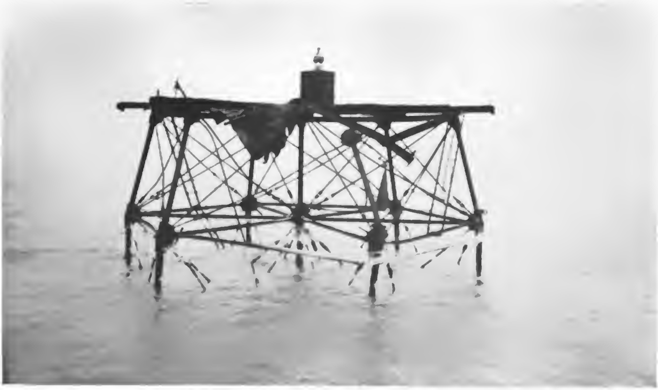
THE SAND ISLAND LIGHT STATION, ALABAMA, BEFORE THE HURRICANE OF SEPTEMBER, 1906



THE SAND ISLAND LIGHT STATION AFTER THE HURRICANE

This storm washed away the island with the keeper's dwelling, and the keeper and his wife were lost (see page 29)

THE ORIGINAL THIMBLE SHOAL LIGHT STATION, VIRGINIA



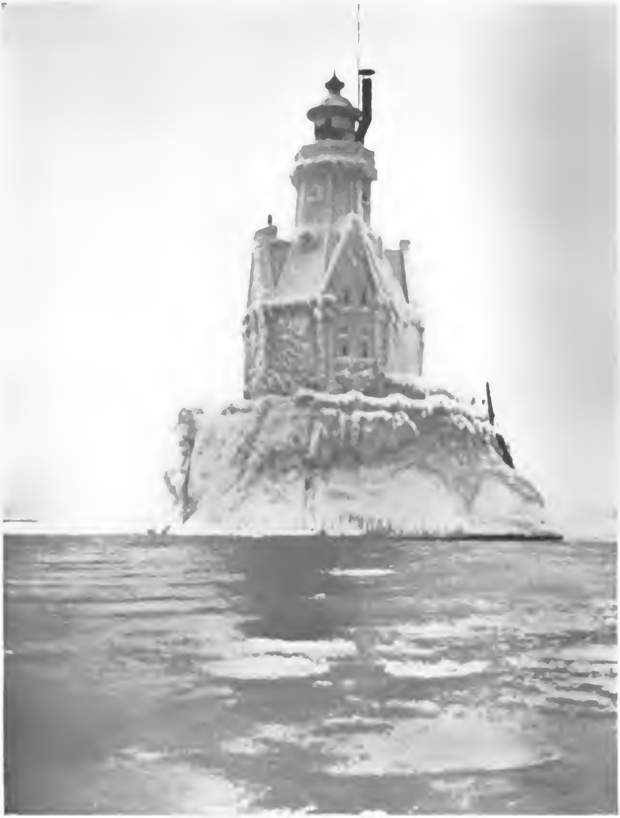
THE THIMBLE LIGHT STATION AFTER A SCHOONER HAD COLLIDED WITH IT AND SET IT ON FIRE

A temporary light is shown, pending the building of a more substantial structure, now under way

while the consumption of oil has been reduced from 2,280 gallons to 1,300 gallons a year.

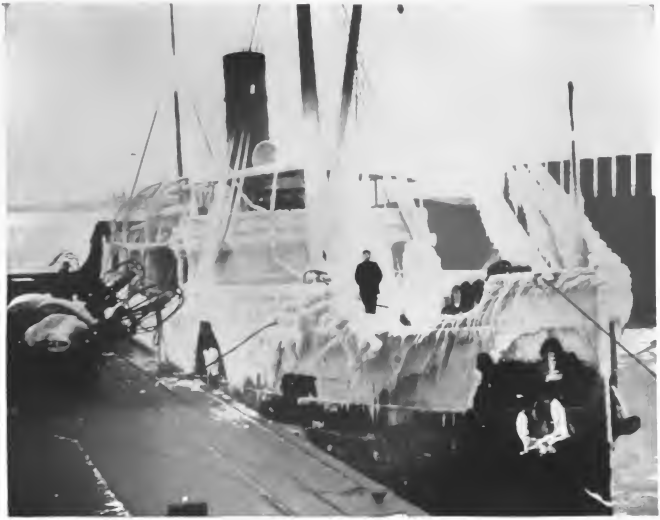
Electric lights are used at a few light stations only. The expense is too great to warrant the employment of electricity at many important stations. For some harbor lights it can be used to advantage by taking current from a local source of supply, and a light can thus be maintained in an exposed position and controlled from the shore.

The electric light at Navesink, on the highlands just south of New York harbor, is the most powerful coast light in the United States. This light shows each five seconds a flash of one-tenth second duration estimated at 60 million candle power. Although, on account of the curvature of the earth, the light itself cannot be seen more than 22 miles, its beam has been reported to have been observed in the sky at a distance of 70 nautical miles (see page 39).



THE RACINE REEF LIGHTHOUSE, IN LAKE MICHIGAN, COVERED WITH ICE

"Winter seriously increases the work of maintaining aids to navigation: the spray or sleet freezing may completely envelop the tower in ice, obscuring the light until the lantern is cleared. In northern waters, where there is floating ice, many of the gas buoys must be removed in winter and replaced by spar buoys, over which the ice may pass without serious damage to the buoy. The spray freezes to bell buoys sometimes until the weight of ice overturns them" (see page 29).



LIGHTHOUSE TENDER CROCUS JUST IN FROM WINTRY WORK ON LAKE ERIE NEAR THE END OF THE SEASON OF NAVIGATION

Most of the lighthouses on the Great Lakes are closed during the winter months, when general navigation ceases on those waters. There is risk to men and vessels in taking off the keepers in the winter gales at the close of navigation" (see page 29).

LIGHTS THAT BURN FOR MONTHS WITHOUT A KEEPER

There has in recent years been a greatly increased use of gas as an illuminant for minor lights, such as unattended lighted beacons and lighted buoys; this is due to the facility with which gas may be stored or generated, the light burning for considerable intervals without attention. There are also a few coal or oil gas harbor lights, supplied from local sources.

There are in use a large number of acetylene gas-lighted beacons, supplied by tanks of gas of sufficient capacity to maintain a quick flashing light for five months without attention. In other acetylene lights the gas is generated from carbide at the station or in the buoy. Oil gas under compression is also extensively used for lighted buoys, having been first employed for this purpose in 1878. Some of the acetylene beacons are provided with a sun valve, which saves gas by automatically cutting off the gas supply during the time the sun shines.

A gas beacon has recently been established on Richardsons Rock, a wave-swept rock west of the Santa Barbara Islands, California. It would have been very expensive to build a lighthouse with keepers' quarters on this rock, so this flashing beacon was established to give present protection to vessels from the danger. This beacon, without attendance, will flash its warnings every 3 seconds for 7 months (or over 6 million flashes) before it requires another charge of gas (see page 36).

Ten years ago the first light in Alaska was established; now there are 95 in that territory, and the rapid increase of recent years has been due largely to the facility

AN UNATTENDED FLASHING GAS LIGHT ON RICHARDSONS ROCK, CALIFORNIA

This light will flash every 3 seconds for seven months before it requires another charge of gas. This would be a difficult and expensive site on which to establish a regular lighthouse with keeper's quarters (see page 35)

with which flashing gas lights, unattended, may be established in that region, where it would be difficult and expensive to maintain keepers. At stations, however, where there are fog signals, keepers must be stationed, as there is not yet available a practical automatic fog signal for land use.

POWERFUL REFLECTORS, LENSES, AND PRISMS ARE USED

In order to increase the effectiveness of illumination, reflectors, lenses, and prisms are used to concentrate the light and throw it out either in a plane around the horizon or in a beam or limited arc, where it will be most useful. Parabolic reflectors were introduced about 1763, and to show around the horizon or to render the light more powerful it was necessary to mount on a chandelier a number of lamps each with its own reflector. Thus in an early list of American lights the number of lamps is given, as Boston lighthouse 14 lamps, and Sandy Hook 18 lamps.

The French physicist, Augustine Fresnel, beginning in 1822, revolutionized lighthouse practice by inventing a system of annular lenses, refractors, and reflecting prisms, all of glass and surrounding a single central lamp. Various forms of lenses designed on these principles, with further improvements, are now universally used in lighthouse work, varying from the simple lens lantern, with a single annular lens, to the great first-order lenses, built of many pieces of beautifully cut and polished glass.

Of such a lens the distinguished lighthouse engineer, Alan Stevenson, wrote: "Nothing can be more beautiful than an entire apparatus for a fixed light of the first order. It consists of a central belt of refractors, forming a hollow cylinder 6 feet in diameter and 30 inches high; below it are six triangular rings of glass, ranged in a cylindrical form, and above a crown of thirteen rings of glass, forming by their union a hollow cage, composed of polished glass, 10 feet high and 6 feet in diameter. I know of no work of art more beautifully creditable to the boldness, ardor, intelligence, and zeal of the artist."

AN ACETYLENE GAS LIGHT, THE FAIRPORT WEST PIER LIGHT, OHIO

Gas tanks at base; light automatically occulting every two seconds. Sun valve to the left of lantern automatically cuts off the light while the sun shines.

With the most complete lenses about 60 per cent of the light is rendered useful, the balance being lost at the top and bottom and by absorption of the glass of the lens and the lantern.

The first lens in the United States was installed at Navesink light in 1841. The largest lens in this service is that at Makapuu Point light, Hawaii, which is 8¾ feet in diameter. The introduction of more powerful illuminants and quick-flashing lights, with lenses concentrating more of the light, has rendered large diameter lenses unnecessary (see page 41).

INGENIOUS METHODS TO DISTINGUISH LIGHTS FROM EACH OTHER

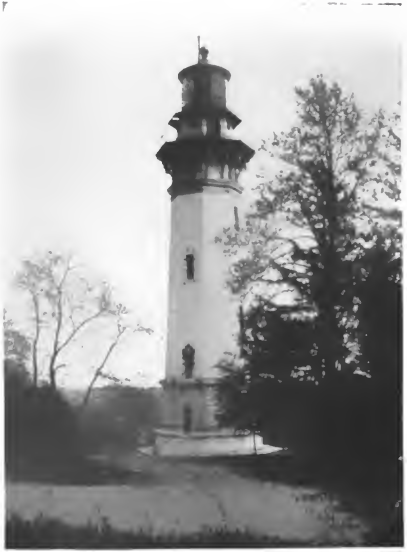
It is important that lights be so distinguished from each other as to avoid the possibility of the mariner mistaking one for another. To this end lights are distinguished by their number, color, intensity, or time of visibility. Before the introduction of flashing or occulting lights, in a few cases two or three light-towers were built close together to give a distinctive combination, an example being the two lighthouses on Thatcher Island, Cape Ann. This is an expensive method not now employed for new lighthouse work.

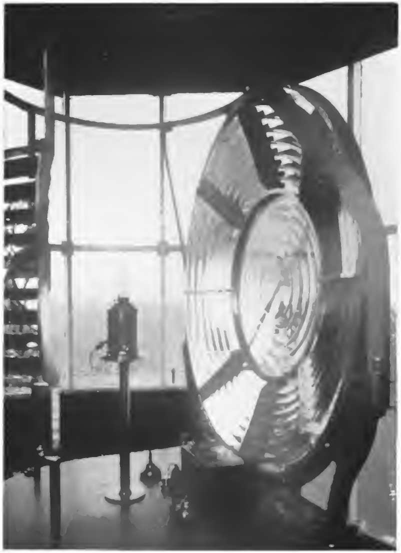
Color distinctions, especially red, have been widely used, but are not suitable except for minor lights because of the great loss of power; with the best color, red, the loss is about 60 per cent. For lights to be seen at close range, two lights are sometimes shown, one vertically above the other.

With the systems now available of flashing and occulting lights, it is possible to obtain a great variety of clearly distinguishable characteristics. The first revolving light was installed in Sweden in 1763. The earlier slow revolving lights are now generally superseded by lights giving a flash or various combinations of flashes at shorter intervals, or lights showing continuously except for short occultations. Quick-flashing lights were first introduced in France about 1892.

The most powerful flashing lights are arranged to have the entire lens revolve, the beam from each panel of the lens appearing as a flash as it sweeps past the observer. To obtain rapid and smooth revolution, the lense is mounted on a mercury float, and a lens weighing, with fittings, as much as 7 tons may make a complete revolution in 30 seconds.

A recent example is the lens for Kilauea light station, Hawaiian Islands, built in France and costing about $12,000, including import duty. The moving part weighs nearly 4 tons and turns on a mercury float, making a complete revolution





VIEWS OF THE STATEN ISLAND LIGHT: THE REAR RANGE LIGHT FOR AMBROSE CHANNEL, NEW YORK

The view of the interior of the lantern shows the fixed lens and reflector with incandescent oil vapor lamp (see page 31). "For the more important lights the incandescent oil vapor lamp is now used, having been introduced by the French in 1898. In this lamp the oil is heated and then vaporized, and is burned mixed with air under a mantle which is made incandescent. This gives a much more brilliant light than the wick lamp, with a smaller consumption of oil. For instance, this change of lamps recently made at Cape Hatteras light has increased the brilliancy of the light from 34,000 to 160,000 candle power, while the consumption of oil has been reduced from 2,280 gallons to 1,300 gallons a year" (see pages [illegible] and [illegible])

THE MOST POWERFUL LIGHT OF THIS COUNTRY, ESTIMATED 60,000,000 CANDLE POWER: THE NAVESINK LIGHTHOUSE, NEW JERSEY

"The electric light at Navesink, on the highlands just south of New York harbor, is the most powerful coast light in the United States. This light shows each 5 seconds a flash of one-tenth second duration estimated at 60 million candle power. Although, on account of the curvature of the earth, the light itself cannot be seen more than 22 miles, its beam has been reported to have been observed in the sky at a distance of 70 nautical miles (see page 33).

every 20 seconds and giving a double flash of about 940,000 candle power every 10 seconds. The light is sufficiently powerful to be visible 40 miles, but because of the earth's curvature it can be seen only 22 miles (see page 42).

Occulting lights are less efficient, the occultations being obtained by revolving a screen around the light, by a drop shutter, or by blank panels in a revolving lens. With gas lights, flashes or occultations may be obtained by automatically interrupting the gas supply, a small pilot light still remaining.

The earlier lighthouses all showed fixed lights, and were equipped with lamps giving only moderate candle power. There is always danger of mistaking the identity of a fixed light, as it may be confused with other lights on shore or on vessels, or one lighthouse mistaken for another, and marine disasters have resulted from such mistakes.

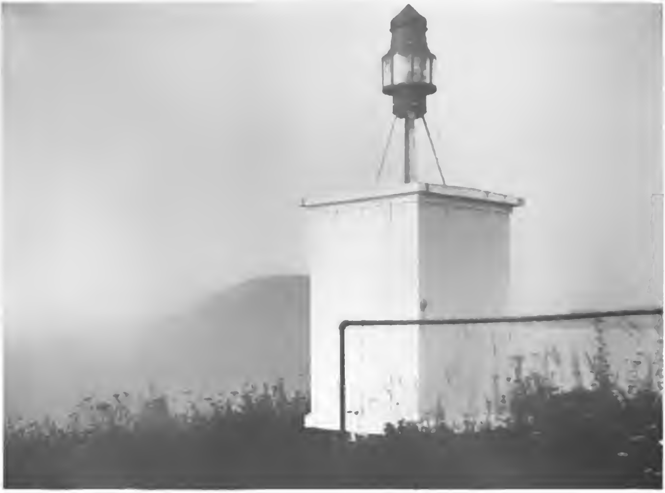
All countries have, therefore, long since undertaken to change the fixed lights at important coast points and give them a distinctive characteristic, and also to increase the brilliancy of illumination.

To indicate the steady progress made along these lines, during the past two years this service has changed 47 lights from fixed to flashing or occulting, and at 68 light stations has substituted incandescent oil-vapor lamps for oil-wick lamps, the latter greatly increasing the brilliancy, with a diminished consumption of oil.

DAYMARKS

In addition to the lights, many other marks are provided to assist navigators. The light-towers themselves are painted and shaped to make good landmarks in the daytime, and special beacons and spindles are placed usually to mark shoals or other dangers. Nature and man also provide many landmarks valu-

AN UNATTENDED FLASHING LIGHT AT THE ENTRANCE TO PRINCE WILLIAM SOUND: THE ZAIKOF POINT LIGHT STATION, ALASKA (SEE PAGE 35)



A LIGHT WHICH FLASHES EVERY 3 SECONDS FOR 5 MONTHS WITHOUT ATTENDANTS

Many such lights have been installed to mark the inside passages in Alaska. This one is placed at Point Retreat, Alaska able to mariners, but which are not included in the official aids.

LIGHT VESSELS

All thus far mentioned are known as fixed aids to navigation, but it is frequently desirable to put marks in the water where the depth or other conditions do not permit of the building of a lighthouse or beacon. More than half the aids to navigation maintained by the Lighthouse Service are floating—light vessels or buoys moored in position.

Light-ships are placed in locations off the coast, where it would be impracticable or needlessly expensive to build a lighthouse, and they usually mark the approach to a port or bay or the outer limit of an offlying danger. They are also sometimes used in inside waters. They may be moored in the channel or close to it, and they have the advantage over most lighthouses, that a vessel may steer directly for them without danger so long as collision with the light vessel is avoided, and also that they may be moved and moored in another position when change of conditions or necessity requires. On the other hand, a light vessel is more expensive to maintain, and there is the possibility of its being driven from its station, though this is reduced in recent years by improved vessels and moorings.

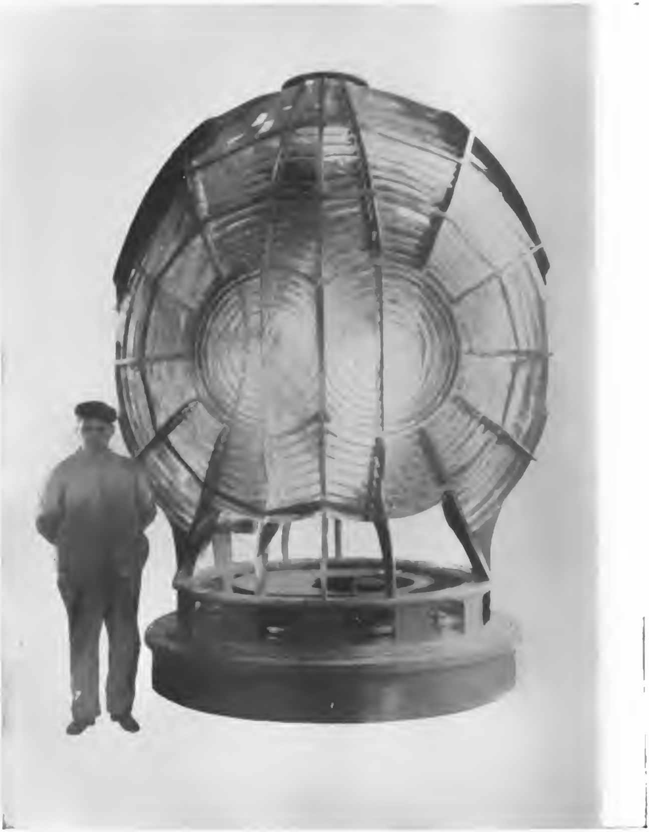
THE LARGEST LENS OF THE U. S. LIGHTHOUSE SERVICE

The lens is 8¾ feet in diameter, an occulting light eclipsed for 1½ seconds each 9 seconds. Makapuu Point Light, Hawaiian Islands.

The first light-ship, the *Nore*, was established in England in 1732, at the mouth of the Thames. The first in this country was stationed in 1820 in Chesapeake Bay, off Willoughby Spit. Sandy Hook, now Ambrose, light vessel was established in 1823. A light vessel was placed off Cape Hatteras in 1824 and was driven ashore in 1827, and a ship was not established again in this dangerous position until 1897, after unsuccessful attempts had been made to build a lighthouse on Diamond Shoal.

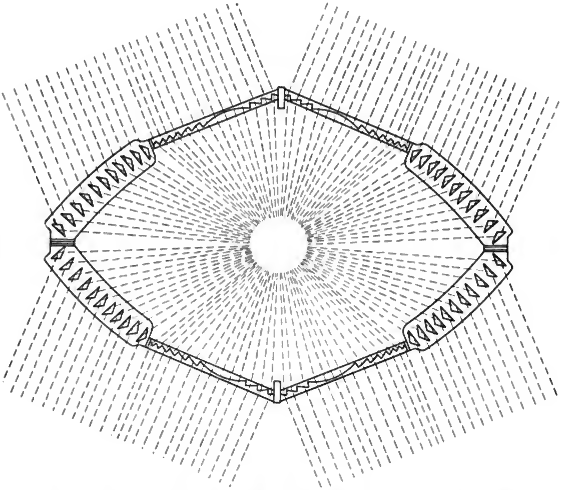
The United States maintains light vessels on 51 stations, and there are a number of relief ships, so that the regular ships may be brought in for repairs. Some of these positions are of the greatest importance to mariners, as, for example, the Nantucket Shoals light vessel, moored 41 miles from land, for which most of the transatlantic vessels steer in approaching America, and the Diamond Shoals light vessel, moored in 30 fathoms of water 13 miles off Cape Hatteras and marking the most dangerous locality on the Atlantic coast of the United States. These larger ships are full-powered vessels, capable of returning to their station, and they each have a crew of 15.

The latest ships are provided with powerful and distinctive lights and fog signals. They more nearly approach the lighthouse in design, having a heavy tubular iron mast surmounted by a lan-



A BEAUTIFUL GLASS LENS AND MOUNTING RECENTLY BUILT IN FRANCE FOR THE KILAUEA LIGHTHOUSE NOW UNDER CONSTRUCTION IN THE HAWAIIAN ISLANDS

It will be the landfall light approaching the islands from Japan. The light will give a double flash of 940,000 candle power every 10 seconds. The lens and mounting "weighs nearly 4 tons and turns on a mercury float, making a complete revolution every 20 seconds and giving a double flash of about 940,000 candle power every 10 seconds. The light is sufficiently powerful to be visible 40 miles, but because of the earth's curvature it can be seen only 22 miles" (see pages 37 and 39).



A CROSS-SECTION THROUGH THE LAMP OF THE LENS SHOWN ON PRECEDING PAGE, SHOWING HOW THE LENS DIRECTS ALL THE LIGHT OUT IN FOUR BEAMS, IN TWO GROUPS

tern, sometimes with a revolving lens supported like a pendulum to hang vertically, so that the light beam will be kept near the horizon regardless of the motion of the vessel. An example is the recently completed Milwaukee light vessel, which will show a double flash every 10 seconds. This vessel has a fog signal giving two blasts each minute, with intervals of 7 and 46 seconds.

LIFE ON THE LIGHT-SHIPS

Life on a light-ship is somewhat dreary, but not without excitement. During every fog the crew on Nantucket ship know that numerous vessels are headed directly for them, and in a storm, anchored as they are in the open sea, they may be far from comfortable. The men in turn are allowed liberal leave ashore. There are often serious difficulties in getting coal and provisions to the ships on exposed stations, so that it is necessary that they carry sufficient supplies to last over stormy periods.

In 1899 the Columbia River light vessel was stranded near Cape Disappointment, and as it could not be gotten off into the sea again, it was hauled 700 yards across the land through the woods and launched in the Columbia River.

The light-ships, being necessarily near the channel ways, are frequently collided with. In January, 1912, a schooner ran into Diamond Shoal light vessel. The master, in his report, describes the damage done and states that "the 6 seamen and also the cook worked manfully all night in trying to save the mainmast," and that "repairs having been made, the light having been kept burning as usual, and the ship kept in right position, unless very severe weather sets in the vessel will stay here until relieved."

The directions of the Superintendent of Lights in 1829 to the master of a light vessel instruct him "not to slip or cut the cable, or suffer it to be done, in any event, and if the vessel should be likely to founder, to abandon her with his crew."

DIAMOND SHOAL LIGHT VESSEL, NORTH CAROLINA

This vessel is anchored in 30 fathoms of water in the Atlantic Ocean 13 miles off Cape Hatteras, and occupies one of the most exposed and dangerous positions. The vessel is shown after being stranded in 1899. The diagram below shows the improved method now in use of mooring light vessels with a submerged buoy.

Notwithstanding the severe conditions, Diamond Shoal light vessel has in recent years been maintained on the station with little interruption. The vessel is now moored with a 7,500-pound mushroom anchor and 150 fathoms (900 feet) of heavy chain. About one-third of the length from the vessel a submerged spherical buoy is attached to the chain, carrying a part of its weight and greatly easing the pull of the vessel.

In recent years some unattended light vessels have been established abroad. These are small vessels without any crew and with all the apparatus automatic in operation. The Barrow light vessel, on the coast of England, with no crew, has an automatic flashing gas light with a revolving lens, a fog bell in the air, and a submarine bell, both actuated by the motion of the vessel in the sea (see page 48).

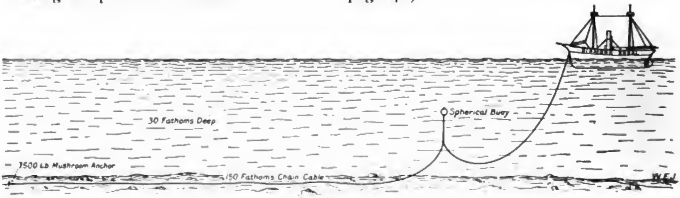
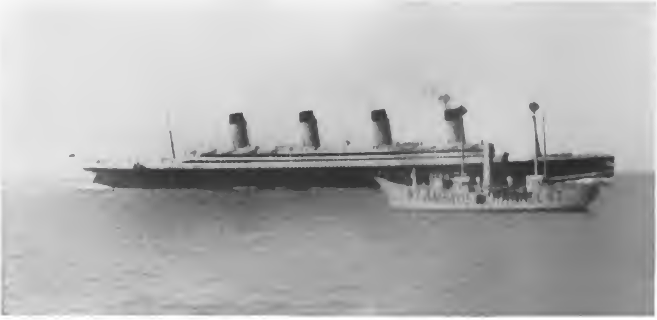


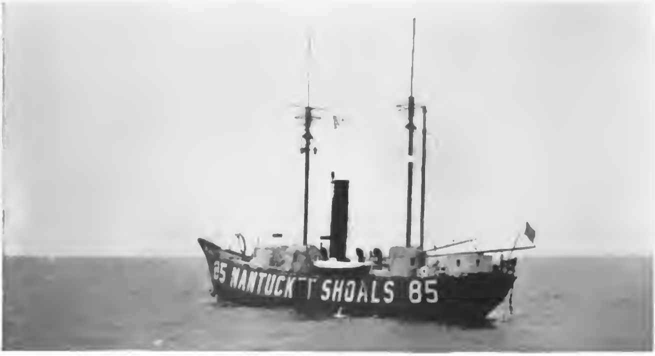
DIAGRAM SHOWING THE MOORING ARRANGEMENT OF DIAMOND SHOAL LIGHT VESSEL

Length of chain on buoy, 7½ fathoms; from the anchor to buoy chain, 105 fathoms; from buoy chain to ship, 45 fathoms



THE AMBROSE LIGHT VESSEL AND AN OCEAN LINER

This light vessel is anchored off the entrance to New York Bay. Ocean passages are reckoned to or from this ship. "Light-ships are placed in locations off the coast where it would be impracticable or needlessly expensive to build a lighthouse, and they usually mark the approach to a port or bay, or the outer limit of an offlying danger. They are also sometimes used in inside waters. They may be moored in the channel or close to it, and they have the advantage over most lighthouses, that a vessel may steer directly for them without danger so long as collision with the light vessel is avoided, and also that they may be moved and moored in another position when change of conditions or necessity requires. On the other hand, a light vessel is more expensive to maintain, and there is the possibility of its being driven from its station, though this is reduced in recent years by improved vessels and moorings" (see page 41).



THE NANTUCKET LIGHT VESSEL, MOORED IN THE ATLANTIC 41 MILES FROM LAND

Most of the transatlantic vessels steer for this vessel. "Life on a light-ship is somewhat dreary, but not without excitement. During every fog the crew on Nantucket ship know that numerous vessels are headed directly for them, and in a storm, anchored as they are in the open sea, they may be far from comfortable. The men in turn are allowed liberal leave ashore. There are often serious difficulties in getting coal and provisions to the ships on exposed stations, so that it is necessary that they carry sufficient supplies to last over stormy periods" (see page 43).

THE COLUMBIA RIVER LIGHT VESSEL, AFTER BEING STRANDED ON CAPE DISAPPOINTMENT IN 1899, WAS HAULED THROUGH THE WOODS 700 YARDS AND LAUNCHED INTO THE RIVER (SEE PAGE 43)

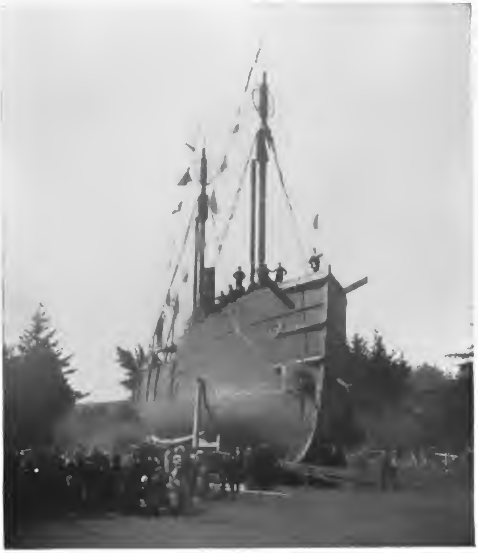
BUOYS

Floating buoys are efficient and relatively inexpensive aids to navigation. They are used to mark dangers—as shoals, rocks, or wrecks—to indicate the limits of navigable channels, or to show the approach to a channel. They vary in character according to their purpose or the distance at which they should be seen. The simpler forms are the wooden and iron spar buoys, and iron can and nun buoys. For warning in thick weather, buoys are fitted with bells, whistles, and submarine bells, all actuated by the motion of the sea.

Some important buoys are lighted, usually by means of oil gas compressed in the buoy itself or acetylene gas compressed in tanks placed in the buoy or generated in it. The light is often flashing or occulting, for the purpose both of providing a distinctive mark and of prolonging the supply of gas. The use of gas buoys has greatly increased in recent years, there being at present 346 in this country. They are a very valuable addition to the aids for the benefit of mariners, and often obviate the necessity of establishing much more expensive light vessels or range lights on shore.

The buoy off the entrance to Ambrose Channel, New York harbor, at a height of 27 feet above the water, shows a light of 810 candle power, occulting every 10 seconds and visible 10 miles. This buoy recently burned for one year and four months without recharging. The buoy is nearly 60 feet long and weighs over 17 tons (see page 50).

Buoys are painted and numbered to indicate their position and the side on which they should be passed. To keep the 6,700 buoys of this country on their proper stations and in good order is a heavy work and is one of the principal



THE COLUMBIA LIGHT VESSEL JOURNEYING THROUGH THE WOODS

uses for the lighthouse tenders. Buoys may be damaged or sunk, or dragged or broken from their moorings by vessels or tows, or wreckage, or ice.

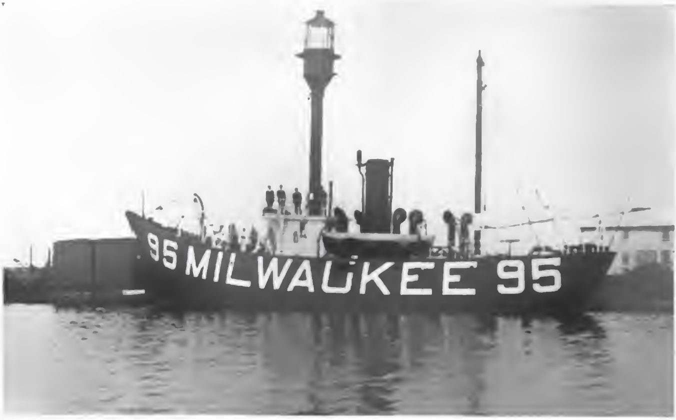
Two buoys from the Atlantic coast of this country have been picked up on the coast of Ireland, and one from the California coast was found in the Hawaiian Islands, these having gotten adrift and been carried across the oceans by the currents.

For use in mooring buoys and light vessels, the Lighthouse Service purchases annually about 15,000 fathoms of chain, a length equal to 17 statute miles.

FOG SIGNALS

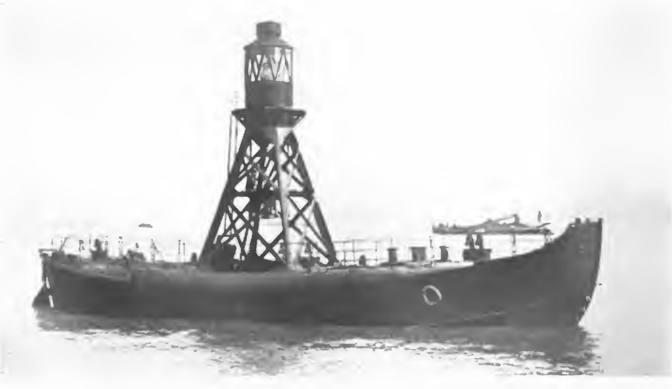
The most powerful coast lights may be rendered of little or no use to navigation by thick fog or rain. To assist vessels under such conditions, making their course more safe or allowing them to proceed, fog signals of many sorts have been established. Of these the bell is the most common, and until about 1850 the only signals in use were bells and guns. The first fog signal on the Pacific coast of the United States was established at Bonita Point, San Francisco Bay, in 1856—a fog gun to be fired each half hour.

The fog signals now in use in the United States consist of sirens, whistles, reed trumpets, aerial bells, and submarine bells. Sirens and whistles are operated by compressed air or steam, and trumpets by compressed air. To furnish air, compressors driven by internal combustion engines are used, and for steam signals boilers are employed. The larger fog bells, up to 4,000 pounds, have hammers actuated by a weight and clock-



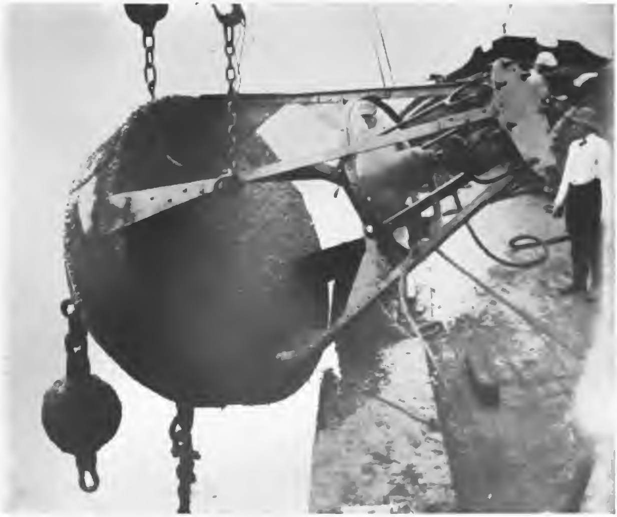
THE MILWAUKEE LIGHT VESSEL, THE LATEST BUILT IN THIS COUNTRY

It has a hollow steel mast, through which access is had to the lantern surmounting it. The lantern will be fitted with a revolving lens giving a flashing light (see page 43)



AN UNATTENDED LIGHT VESSEL ON THE COAST OF ENGLAND

It has no crew, and is equipped with flashing gas light, aerial fog bell, and submarine fog bell, all automatic. The bells are operated by the motion of the vessel in the sea



A BELL BUOY TAKEN ON BOARD LIGHTHOUSE TENDER

Shows marine growth and the necessity for periodic cleaning and painting of buoys

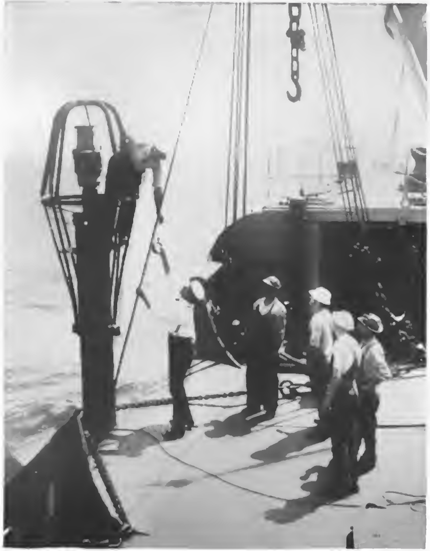
work. The smaller bells are rung by hand. Besides the above, there are various noise-making buoys; bells, whistles, and submarine bells are attached to buoys and are made to sound by the movement of the buoy due to the sea.

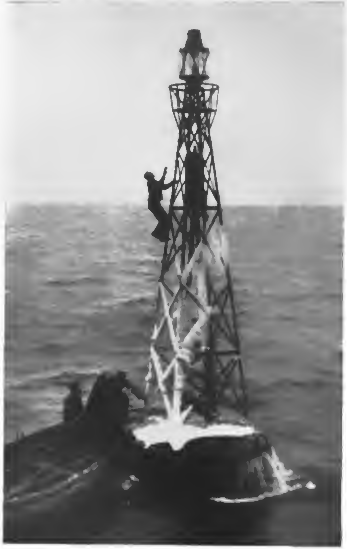
There are also used abroad several other types of fog signals. The diaphone, similar to the siren, explosive signals, consisting of a tonite or other explosive fired from the top of a mast, and recently there has been installed, experimentally, at several light stations in France apparatus for sending signals by wireless telegraphy, and a compass has been invented which from a vessel will give the direction of the sending station.

Nearly all fog signals excepting those on buoys are operated to sound a characteristic signal so that they may be distinguished, there being a succession of blasts or groups of blasts or strokes at regular time intervals, which are made known for each station. Even adjacent buoys are differentiated by the use of whistles and bells and by variation of tone.

A first-class fog-signal station requires powerful and expensive machinery and skilled attendance. Such a station may have duplicate engines of 20 horsepower each, and the signal may consume 100 cubic feet of free air per minute.

While aerial fog signals furnish a very valuable aid to navigation under weather conditions when assistance is most needed, yet they are far from the ideal of perfection. Sounds are transmitted through the air erratically, and sometimes within a comparatively short distance of a station the fog signal may be inaudible, while in other directions it may be heard for long distances. This is due to the effect of the adjacent land or to conditions in the atmosphere, the sound being reflected or the sound waves





GAS BUOY ALONGSIDE A TENDER, BEING RECHARGED WITH OIL GAS

The great gas buoy off New York entrance with light 27 feet above the water, which recently burned for 16 months without attention, occulting every 10 seconds deflected or retarded; the subject is one of importance, requiring further investigation.

There is sometimes an unfortunate conflict of interest between the need of a loud and distinctive sound to aid the mariner in a fog and the quiet and comfort of seashore residents in whose midst the fog-signal station may be located. Even the mournful note of the whistling buoy may bring complaints from the near-by shore residents.

Keepers at fog-signal stations must maintain a continuous watch day and night, as the signal must be started promptly on the approach of fog. Some portions of the coast have little or no fog, as on the south Atlantic and Gulf coasts, where there are but few fog signals; there are no fog signals in Porto Rico or in the Hawaiian Islands. Fogs and thick weather are very prevalent on the New England and the Pacific coasts. At the station at Seguin Island, Maine, there were, in 1907, 2,734 hours of fog, more than 30 per cent of the entire year.

SUBMARINE BELLS

Submarine bells were first regularly employed as fog signals in the United States in 1906. The bell is suspended in the water from a light vessel to a depth of 25 to 30 feet and is operated by compressed air, or the bell is mounted on a tripod on the bottom and worked by electric power transmitted from the shore through a cable, or it is suspended from a buoy and actuated by the motion of the sea, which moves a vane and winds a spring (see page 52).

Sound from submarine bells is transmitted through the water more uniformly and effectively than it is through the air from an aerial signal, but the efficient use of submarine bells requires that vessels be equipped with suitable receiving apparatus attached to the hull on each bow and telephonically connected with the wheel-house; by comparing the loudness on the two sides the direction of the signal may be obtained. Submarine bells have frequently been heard through the water at distances of 15 miles and more.

LIGHTHOUSES MAINTAINED BY ALL COUNTRIES

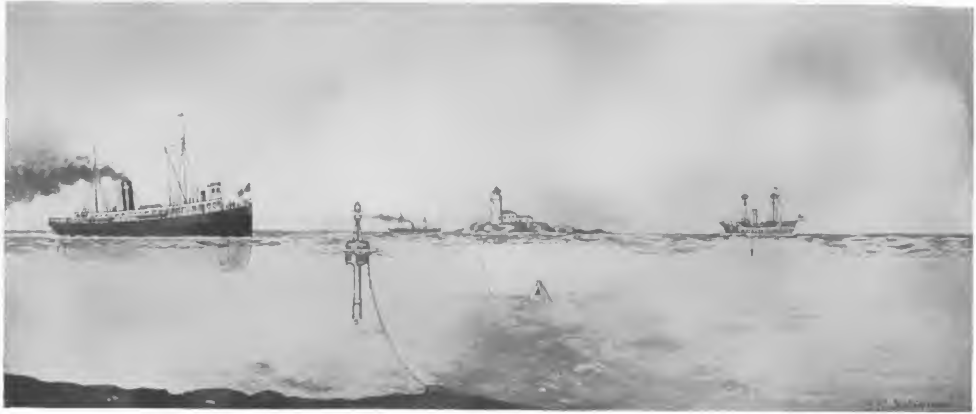
As of the surface of the earth 51,886,000 square miles is land, as compared with 145,054,000 square miles of water, it is evident that a large part of the commerce of the world will always be carried on this great water area. Lights and buoys and fog signals are essential to safeguard the ships as they approach the continents and follow the coasts, and these or other suitable guides will be needed for aerial traffic, should it ever develop.

The proper lighting and marking of the coasts is an obligation assumed by all modern maritime nations. The lights protect not only the ships of the country maintaining them, but the vessels of other nations as well. The lighthouse, for instance, at Cape Maysi, on the east end of Cuba, is of great value to many ships which never call at a Cuban port. A lighthouse on Cape Spartel, Africa, at the entrance to the Mediterranean, is maintained jointly by the contributions of 11 nations, including the United States.

But there is a great difference today in the manner in which the shores of different seas are lighted. The official British lists give a total of about 11,600 lighthouses and light-ships for the entire world, but of these 8,900 are on the coasts of Europe, the United States, and Canada, while Asia, Africa, Australia, the remainder of America, and the islands of the sea have together about 2,700. South America has but 300 lights, and Africa 500.

A region of interest to our shipping, much of which is badly lighted and marked, is the area including the Caribbean Sea, the West Indies, and Central America. For example, the large island of Haiti has not a lighthouse at any one of its three prominent extremities. The only lights on Haiti are four harbor lights, which are marked in the list "not to be depended upon." A number of the lighthouses on the Central American coast are maintained by an enterprising steamship company.

Around the entire shore line of Bering Sea there is but one lighthouse—that at



SUBMARINE BELL FOG SIGNALS

The submarine bell is suspended from a light vessel and operated by compressed air, or the bell is mounted on a tripod on the bottom and worked by electric power from the shore, or it is hung from a buoy and actuated by the motion of the sea. Sound is transmitted through the water more uniformly than through the air, and submarine bells have been heard at distances of 15 miles and more by vessels equipped with receiving apparatus.

Cape Sarichef, Alaska—and some small lights near St. Michael; but this is a region where the commerce would not at present justify a costly lighting system, particularly as navigation is mostly confined to the season of no darkness at night.

It seems almost incredible to find, only three centuries ago, powerful opposition to the establishment of lighthouses. In 1619 a heroic Cornish gentleman, Sir John Killegrew, petitioned the king for permission to build a lighthouse on the Lizard, the southernmost point of England, where there is now an electric light whose powerful beam sweeps around the horizon. The nautical board to whom was referred the petition advised the king that it was not "necessarie nor convenient on the Lizard to erect a light, but, *per contra*, inconvenient, both in regard of pirates, or foreign-enemys; for the light would serve them as a pilot to conduct and lead them to safe places of landinge; the danger and perill whereof we leave to your majesty's absolute and profound wisdom." Notwithstanding the flattery, James I granted the petition.

Next the local Cornish people opposed the work, as thus told by Killegrew: "The inabytants neer by think they suffer by this erection. They affirme I take away God's grace from them. Their English meaning is that now they shall receive no more benefitt by shipwreck, for this will prevent yt. They have been so long used to repe profitt by the callamyties of the ruin of shipping, that they clayme it heredytarye, and heavely complayne on me." The light was, however, completed and the fire kindled, which, wrote Killegrew, "I presume speaks for yt selfe to the most part of Christendom." But it was impossible to obtain, for supporting it, the "voluntary contributions" from shipping which the king's grant authorized. Finally the corporation of the town of Plymouth pulled down the lighthouse, which the shipowners considered "burthensome to all ye countrie," and there was no light at the Lizard for 132 years thereafter.

Some of the early lights and buoys in England were maintained by religious men. On a tradition of such a philanthropy is founded Southey's ballad regarding the buoy on Bell Rock, where now stands a great lighthouse:

"The good old Abbot of Aberbrothock
Had placed that bell on the Inchcape Rock;
On a buoy, in the storm, it floated and swung,
And over the waves its warning rung.

"When the rock was hid by the surge's swell,
The mariners heard the warning bell;
And then they knew the perilous rock,
And blessed the Abbot of Aberbrothock."

THE DISCOVERY OF CANCER IN PLANTS

An Account of Some Remarkable Experiments by the U. S. Department of Agriculture

With Photographs by Dr. Erwin F. Smith

THERE is no disease to which mankind is liable more productive of intense suffering than cancer, and yet its origin is unknown and no certain method of cure has yet been discovered.

In recent years, particularly during the last decade, the attention of experts in medical research all over the world has been more and more focused upon this subject. Thanks to the munificent coöperation of various public bodies and individual philanthropists, a number of splendidly equipped laboratories have been founded, and international congresses are held from time to time, at which investigators from all parts of the world submit the results of their researches. But, in spite of much patient and laborious investigation, no definite clue has been found, and we are still apparently far from a knowledge of the causes producing this disease.

This is the more unfortunate because, if we may trust the statements of statisticians, cancer is becoming increasingly

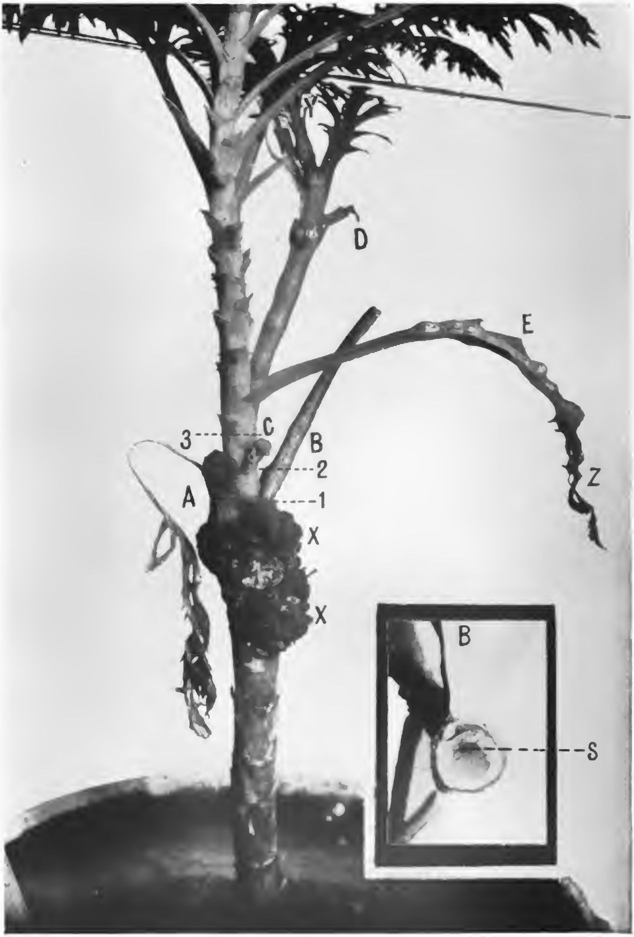


PLATE I. A MARGURITE OR PARIS DAISY IN WHICH PLANT CANCER HAS BEEN PRODUCED BY INOCULATION (SEE PAGE 61)

"A sterilized needle is taken and dipped into the culture containing the bacteria and one or more small pricks are then made in the skin of the plant. After a few days nodules appear."

common. According to the very carefully prepared statistics covering the death rate in England and Wales, it appears that while in every million living in 1871-1875 the annual death rate from cancer was 445 cases, in 1901-1904 the rate had risen to 861 cases. With an increase so appalling, the need of discovering the cause and cure of this disease is urgent.

WHAT THE CELLS ARE

Cancer is a disease of the cells of the body, and to obtain a clear idea of its nature it will be necessary to consider very briefly the cells as the living units of protoplasm, of which all bodies, both of plants and animals, are composed. For example, the human body has its origin in the union of two small cells, and the single cell thus produced divides in its turn into two, these two into four, each cell dividing upon an arithmetical progression of 2 . 4 . 8 . 16 . 32 . . . . with incredible rapidity. Some conception of the diminutive size of these cells can be formed when we know that ten days after the union of the original male and female cells the cell-structure, which will ultimately develop into the human body, has attained the size of a pin's head, yet it contains hundreds of thousands of cells.

All cells act automatically and reproduce themselves under internal or external stimulus, but only in accordance with the needs of the body to which they belong. Just what that stimulus is and how it is caused is still a matter of some obscurity, but recent researches by Dr. Alexis Carrel, of New York, and many others tend to show that all normal cell stimulation, as far as the human body is concerned, is due to secretions produced by certain cell-groups, such as the pancreas, the thyroid, and other glands.

So long as this automatic self-division of cells, or proliferation, as it is called, coincides with the needs of the body, a normal condition exists.

HOW A CANCER BEGINS

A cancer results from an abnormal proliferation of certain of these cells. When from some still unknown reason a cell is stimulated to abnormal, malignant proliferation it becomes the mother cell of the cancer and gives rise to daughter cells, which often multiply with immense rapidity and so on indefinitely. These abnormal cells also react upon normal cells and stimulate them also into rapid growth until the typical cancer is formed.

A great number of theories have been put forward to account for this abnormal cell growth, the more important being the following: Virchow's theory, which attributes all tumors and cancer to the direct results of injury or irritation; Cohnheim's theory, which accounts for cancer by a supposition that during embryonic life certain cells are isolated or "displaced from their normal relationship or fail to undergo normal atrophy" (Adami, Principles of Pathology, vol. 1, p. 835), the result being that they lie dormant until roused into activity by some stimulus, and that, having the enormous power of proliferation which characterizes all embryonic cells, they outstrip the adult cells and a cancer results.

Those who maintain these and other theories of the non-parasitic origin of cancer, and they constitute at present the major part of all research workers in the field of cancer, have always maintained that this disease cannot be parasitic, not only because no one has ever been able to isolate or demonstrate any parasite, but also, they claim, because the cancer cell is itself the parasite. Cancer, as of rats, mice, etc., cannot be reproduced, they have said, except by the introduction into the animal experimented upon of living cancer cells, usually from another animal of the same species.

THE PARASITIC THEORY

The parasitic theory, however, has enthusiastic supporters, and is still a matter which excites keen discussion in medical circles. As will be shown later, it is along this line that present indications show the greatest promise of future results. This theory holds that cancer is due to an abnormal stimulation produced by some still undiscovered microorganism, and its adherents point out that cancer, with its localized primary growth and widespread secondary infections, bears a remarkable similarity to

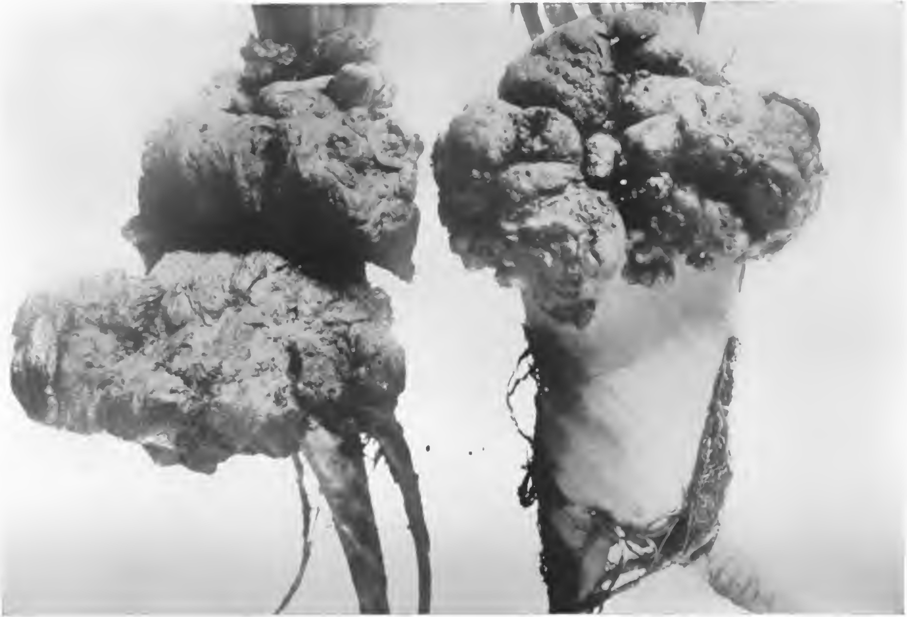


PLATE II. PLANT CANCERS PRODUCED BY INOCULATION ON SUGAR BEETS: PHOTOGRAPHED TWO MONTHS AFTER INOCULATION TO SHOW THE RAPIDITY OF THE MALIGNANT GROWTH (SEE PAGE 61)

certain other diseases which are known to be of parasitic origin.

Dr. Borrel, of the Pasteur Institute, has found animal parasites (acarids) buried in the cell masses of certain cancers of the face, and he conceives that possibly these parasites introduce an organism or a poison much in the same way as the mosquito introduces the malaria virus into the system. Still more recently (1911-1912) Dr. Peyton Rouse has announced* that a chicken sarcoma (cancer) is inoculable in the absence of cancer cells, and that the tumor material, even when dried for six months, is still infectious.

THE LATEST DISCOVERY

But perhaps the strongest support of the parasitic theory of cancer has come from what at first sight would seem to be the most unlikely source, namely, the Bureau of Plant Industry of the U. S. Department of Agriculture. This, however, is not so remarkable when we remember that cancer is a disease resulting from abnormal cell stimulation, and that the cell is substantially the same in both plants and animals.

Indeed it is to comparative pathology that we must look for the most striking results of our future investigation.

For some nine years past Dr. Erwin F. Smith, the pathologist in charge of the Laboratory of Plant Pathology of the Department of Agriculture, and his assistants have been conducting a series of investigations into the origin and histology of the crown gall.

The crown gall is a plant disease which causes an annual loss to farmers of millions of dollars and has become a serious problem to the agriculturist on account of the number of species of plants liable to its ravages. It is known to attack the daisy, the almond, peach, and other stone fruits, the apple, quince, raspberry, blackberry, the rose, the grape, red clover, alfalfa, cotton, hops, sugar-beets, and various shrubs, hot-house plants, and shade trees. Up to the time that Dr. Smith undertook his investigations its cause and character were entirely unknown.

A NEW BACILLUS FOUND

He has proved the parasitic nature of this disease (Bulletin 213), and now states (Bulletin 255) that it is nothing more or less than a plant cancer, since it is due to parasitic stimulation going on within the cells and leading to abnormal proliferations essentially like those present in cancer of men and animals.

While Dr. Smith has surrounded his conclusions with all those qualifications so dear to the modesty of the scientist, there is no doubt that he has made a discovery of the first magnitude in pathology, and has indicated a line of research which investigators of human cancer will be unable to ignore.

In 1904 the Department of Agriculture received a number of margurites, or Paris daisy plants, which were infected with gall-like growths on the stems and leaves. They were sent in to the Department by one of the large commercial growers in New Jersey, accompanied by the statement that the galls appeared, without apparent cause, both on plants grown in the open in summer and under glass in winter.

HOW THE DAISY HELPED

The first result obtained from the investigations undertaken by Dr. Smith was the establishment of the fact that these growths were not due to insect injuries. The next step was to discover whether the galls were due to infection by fungous growths, and this was decided in the negative after very conclusive experiments. The possibility of these growths being due to bacteria next presented itself and was investigated, but for some time the results obtained from the experiments were so inconclusive that the bacterial hypothesis was temporarily abandoned. Every effort was then made to produce the galls by mechanical injuries practised upon the plants in every stage of growth, but experiments in this direction were fruitless.

More than two years of careful investigation had been consumed before Dr. Smith and his assistants were able, by bacteriological culture-methods, to isolate any organism which would reproduce the disease when plants were inoculated

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* Journal American Medical Association; American Association for Cancer Research; Journal Experimental Medicine.

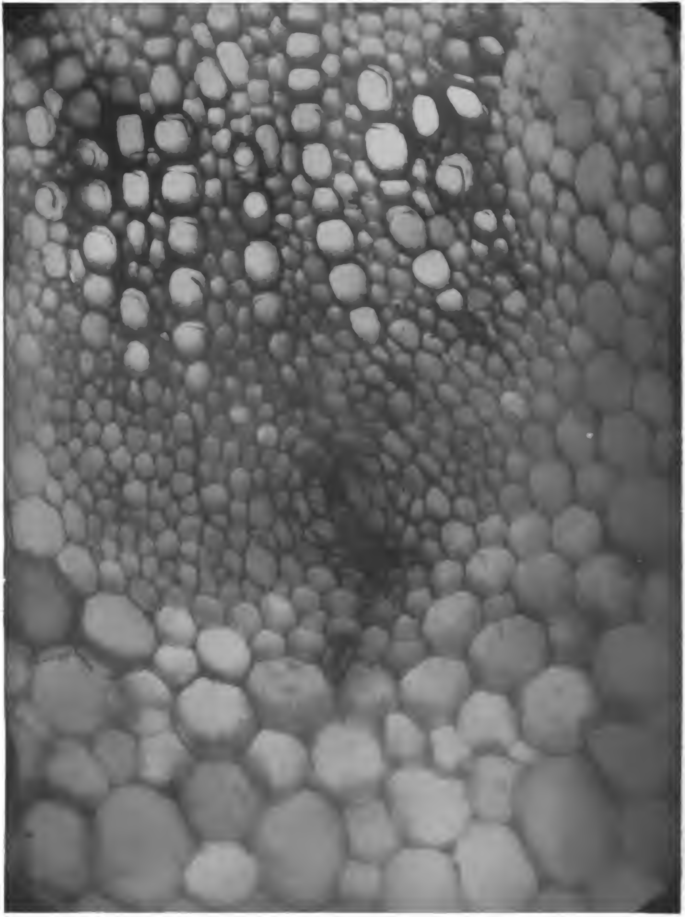


PLATE III. A CROSS-SECTION OF A PLANT SHOWING BOTH NORMAL AND DISEASED CELLS (SEE PAGE 61)

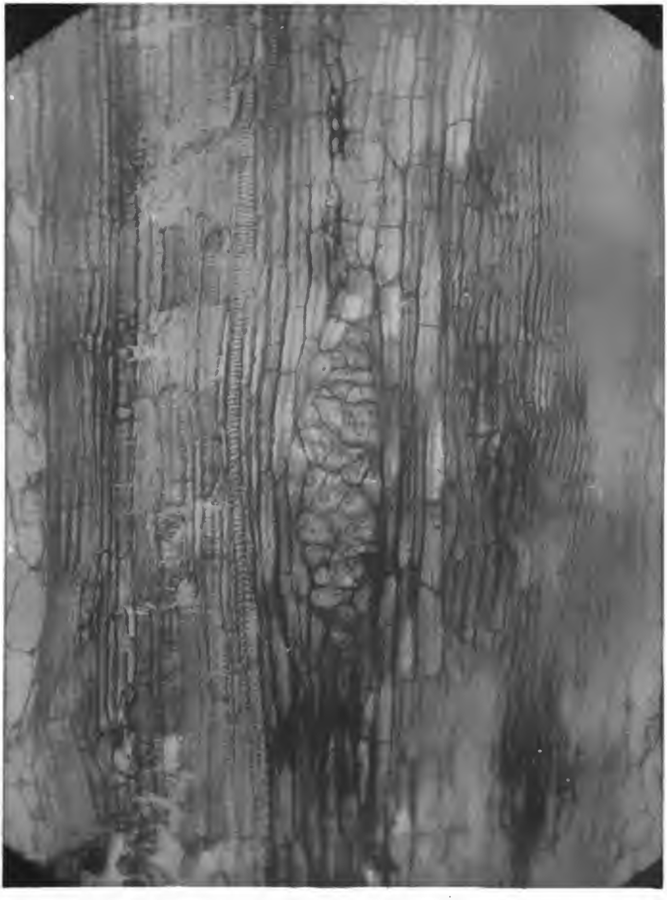


PLATE IV. A LONGITUDINAL SECTION SHOWING HEALTHY AND DISEASED CELLS IN THE SAME PART OF THE PLANT STEM AS SHOWN IN PRECEDING PHOTOGRAPH (SEE PAGE 66)

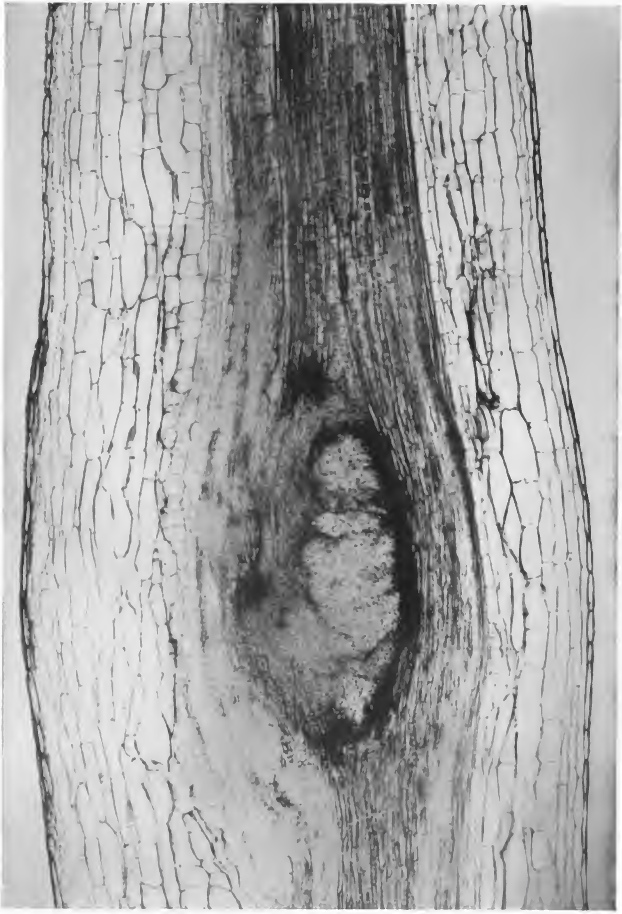


PLATE V. THE EFFECT OF THE CONTINUED ABNORMAL GROWTH OF THE CANCER CELLS IS SHOWN IN THIS LONGITUDINAL SECTION OF A PLANT STEM

The tumor in course of formation is very apparent (see page 66) with it. They finally succeeded in separating a white bacterio-organism found in the tumors which they discovered would produce the crown gall when introduced into a healthy plant. This they have named the *Bacterium tumefaciens,* or tumor-producing organism.

Subsequent experiments showed that the most uniform success followed experiments upon young and rapidly growing plants, it being often possible to obtain 100 per cent of infections. But eight years passed before they were able satisfactorily to stain the organism in the tissues so that it could be demonstrated under the microscope.

Still further work was necessary before Dr. Smith was convinced that the time had come when this disease could be properly described as plant cancer.

THE PLANT CANCER DISCOVERED

These results have been announced in two luminous bulletins of the Bureau of Plant Industry, Nos. 213 and 255, containing a series of admirable photographs and photo-micrographs, which show the plant cancer in all its variations.

With the aid of some of these photographs, we will follow Dr. Smith through one of his experiments, showing how the cancer is produced; how it sends out tumor-strands from the original point of infection; how secondary cancers develop from these tumor-strands; also the different structure of primary and secondary leaf tumors, and finally we shall see both the disturbance produced in the normal cell structure and the *Bacterium tumefaciens,* which is responsible for the trouble.

In Plate I (page 54) we have one of the Paris daisies, or margurites, which served as the medium for very many important experiments. A sterilized needle is taken and dipped into the culture containing the bacteria, and one or more small pricks are then made in the skin of the plant. After a few days nodules appear, which finally grow into the primary cancer, producing the malformations shown in this plant at the points marked X, where the inoculations were made. From this point the cancer begins to throw out its roots or tumor-strands, which work their way up and down the stem and into the leaves, throwing off secondary cancers as they pass. These secondary cancers can be plainly seen at the points marked A and C, where they have ruptured to the surface, while a number of them, still buried in the normal tissues, are visible along the leaf E, with others at D.

In the right-hand corner of the plate there is a cross-section of the stem taken at the point marked 1, which shows how a large tumor-strand (marked S) appears to the naked eye.

WHAT A TUMOR-STRAND IS

This tumor-strand is of great importance in determining the cancerous nature of the gall disease. In the Encyclopædia Britannica, Dr. Louis Courtland says: "A cancer follows a course very different from that of an innocent tumor. Its growth has no appointed termination, but continues with unabated vigour until death; moreover, it is more rapid than that of the innocent tumours, and so does not permit of the formation of a capsule by the neighboring tissues. In consequence such a tumour shows no well-defined boundary, *but from its margin fine tendrils of cancer cells make their way in all directions into the surrounding parts,* which gradually become more and more involved in the process. Thus a cancer of the breast will attack both the skin covering it and the underlying muscle and bone; a cancer of the intestine will eat its way into the liver, spleen and kidney, until these organs become to a great extent replaced by cancer cells, and can no longer perform their proper functions."

In this tumor-strand, therefore, we find just exactly what we should expect to find in a plant suffering from cancer. The enormous rapidity with which plant cancers may develop is shown on Plate II, which exhibits two sugar-beets inoculated by needle pricks with pure culture, the photograph being made only two months after the roots were infected.

WHAT CELLS LOOK LIKE

We will now turn to Plate III and see how the tumor-strand disturbs the normal cell structure. This plate shows a

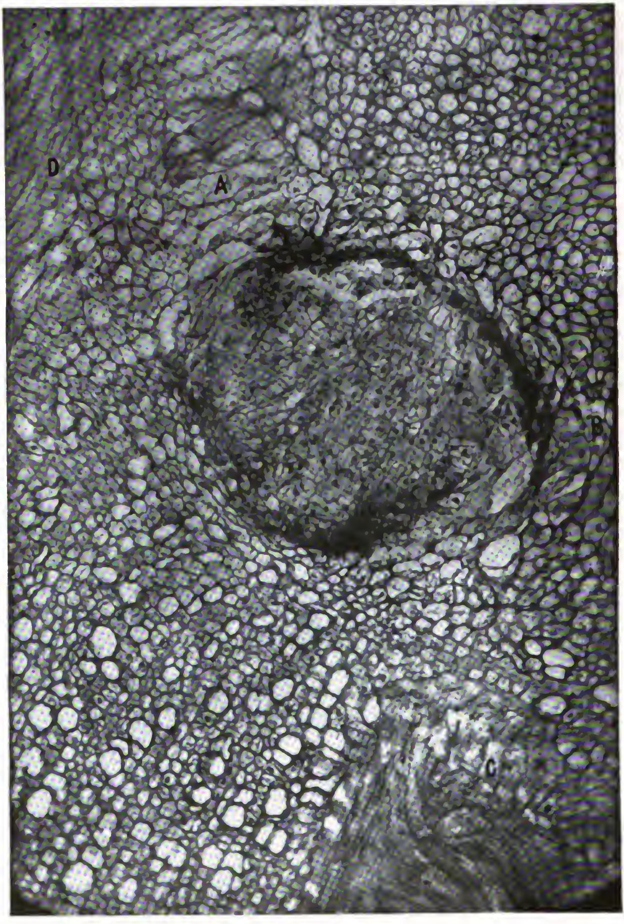


PLATE VI. THE CANCER ROOT OR TUMOR-STRAND AS IT LIES IN THE SURROUNDING TISSUE, SHOWING THE NUCLEI OR POINTS FROM WHICH CELL DEVELOPMENT STARTS (SEE PAGE 66)

Note the black spots in this and the following photograph. These spots are the nuclei or points from which the proliferation starts, due to the stimulation of the parasite

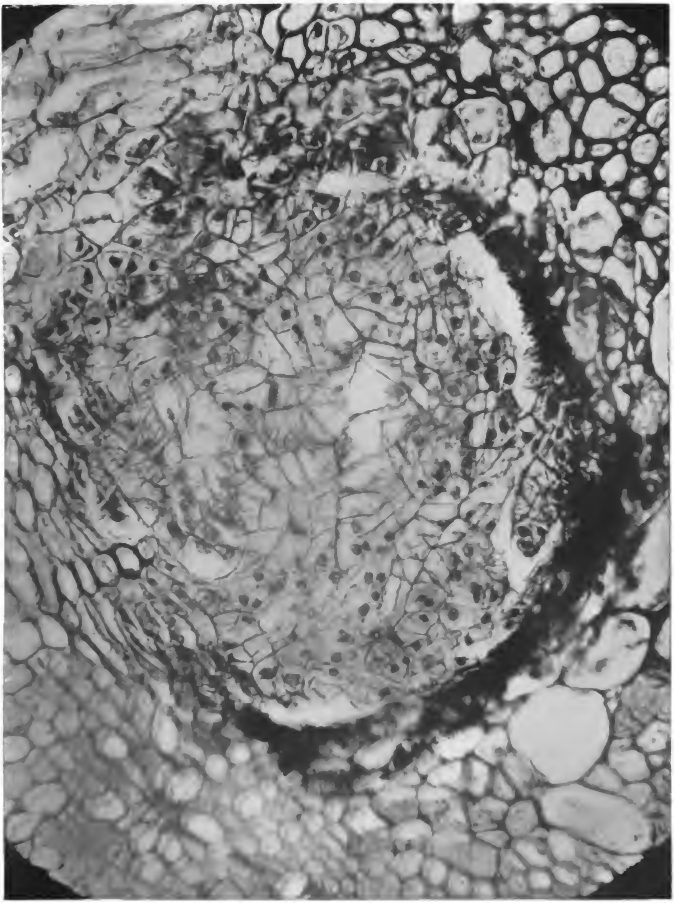


PLATE VII. AN ENLARGEMENT OF THE TUMOR-STRAND SHOWN IN THE PREVIOUS PLATE, SHOWING A CLEARER VIEW OF THE NUCLEI

Note the black spots, or centers of activity, are very prominent (see preceding plate)

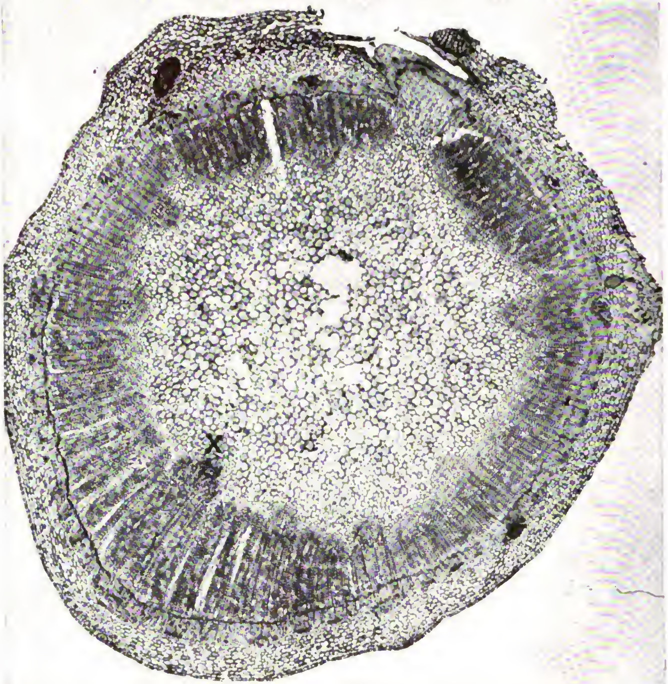


PLATE VIII. THE CROSS-SECTION OF A STEM BETWEEN TWO TUMORS, SHOWING THE SMALL TUMOR-STRAND (AT POINT X) WHICH CONNECTS THEM (P. 66)

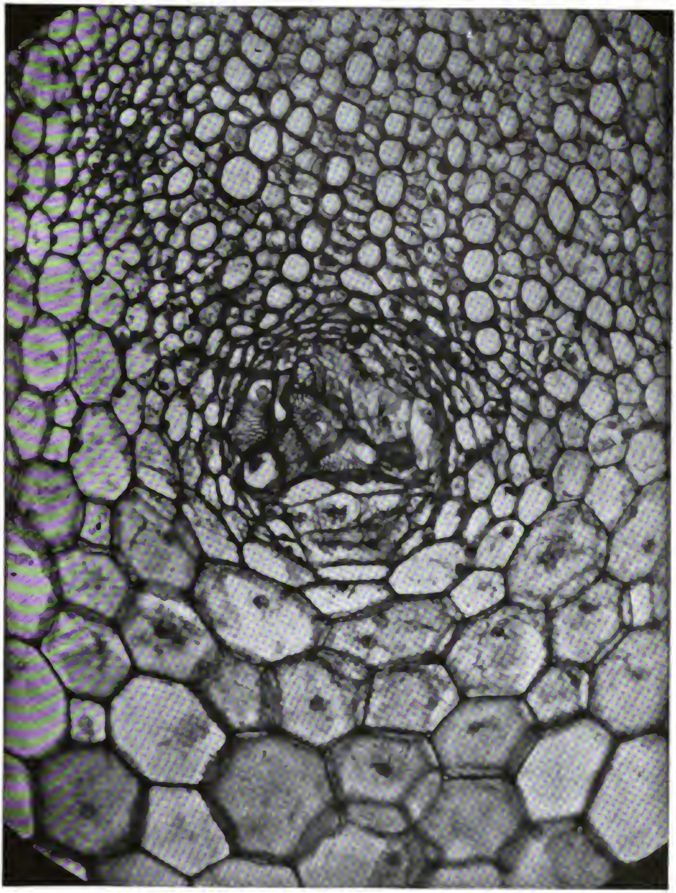


PLATE IX. AN ENLARGED PHOTOGRAPH OF THE SMALL TUMOR-STRAND OF THE PREVIOUS PLATE

Showing how the cells have been displaced from their normal relationship, which supports Cohnheim's hypothesis (see pages 55 and 66) typical cell formation in the stem of a plant as it appears in a cross-section or looking down upon it from above. This is a photo-micrograph, and the tiny cells have been magnified until, taken collectively, they look like a cobblestone pavement; but we can now see how the cells look when they are subject to both normal and abnormal stimulation. The great majority of the cells shown here are behaving quite normally, but in the center of the picture, where the large pith-cells join the smaller wood-cells, we notice a little group of cells which seem to be different from the others and to be forming a little circular colony of their own. These are the cells which, under the stimulus of the cancer bacillus, form the tumor-strand.

Just how abnormally these cells are behaving will be immediately apparent when we view a tumor-strand in longitudinal section or in a front view as given in Plate IV. Here the cells in the tumor-strand, which is shown in the center of the plate and looks not unlike a sweetbread, have a markedly different appearance from those of the normal tissue surrounding them. The effect of their continued abnormal growth is shown in Plate V, where a young tumor is developing, while a more detailed photograph of a cross-section of a tumor-strand lying in the midst of less abnormal cells is shown on Plate VI.

THE NUCLEUS AND ITS FUNCTION

This is a particularly interesting plate, as it shows that the tumor-strand, just like many human cancers, has a strong affinity for the stain used upon the microscope slide, and this shows especially at the edges of the strand, which appear quite dark. A series of small black spots will also be observed, very numerous in the cells in the tumor-strand and appearing at intervals in a few cells on other parts of the plate. These spots are the nuclei or points from which proliferation starts, and the superabundant proliferation in the tumor-strand, due to the stimulation of the parasite, can be easily seen.

An enlargement of the tumor-strand area is given in Plate VII, which affords a much clearer view of the nuclei. It will be observed that these points of proliferation are distributed all over the tumor-strand area, but are especially numerous at the edges.

Plate VIII shows a cross-section of the stem of a daisy plant between the primary and secondary tumors. The tumor-strand occurs at the point x, and the rest of the stem is quite normal except for a slight thickening of the ring of wood-cells at the point nearest the tumor-strand.

An enlargement of this tumor-strand and the surrounding cells appears in Plate IX, the tumor-strand being at the junction of the small wood-cells above and the larger pith-cells below. Here in the tumor-strand we have the cells "displaced from their normal relationship." referred to in Cohnheim's hypotheses (see p. 55), the pitted portion being vessels (trachids) which have developed out of place and still contain nuclei which are absent from these vessels when fully developed. They also show, by their feeble staining, that they are still in process of of development, as adult vessels of this type usually stain heavily.

HOW PLANT CANCER DESTROYS TISSUE

A cross-section of a leaf stalk in which a tumor has developed is shown in Plate X. The ravages of the cancer can be appreciated when we realize that the light-colored cells at the top and left are all that is left of the normal tissue. This is a secondary tumor developed from a tumor-strand which has pushed its way up from a primary tumor situated on the stem below, and consequently it has an imperfect stem structure, consisting of a central tumor-strand, which takes the place normally occupied by the pith. From it radiate in all directions woody plates (the dark rays in the picture), separated by enlarged pith rays (the light rays), the whole being inclosed by a ring of bark cells. The great excess of soft cells leading to rapid decay and the absence of pith are the chief differences between this and a normal stem.

The very striking contrast between such a secondary leaf tumor and a primary leaf tumor can be seen in Plate XI, which is a cross-section of a primary leaf tumor produced from a pure culture

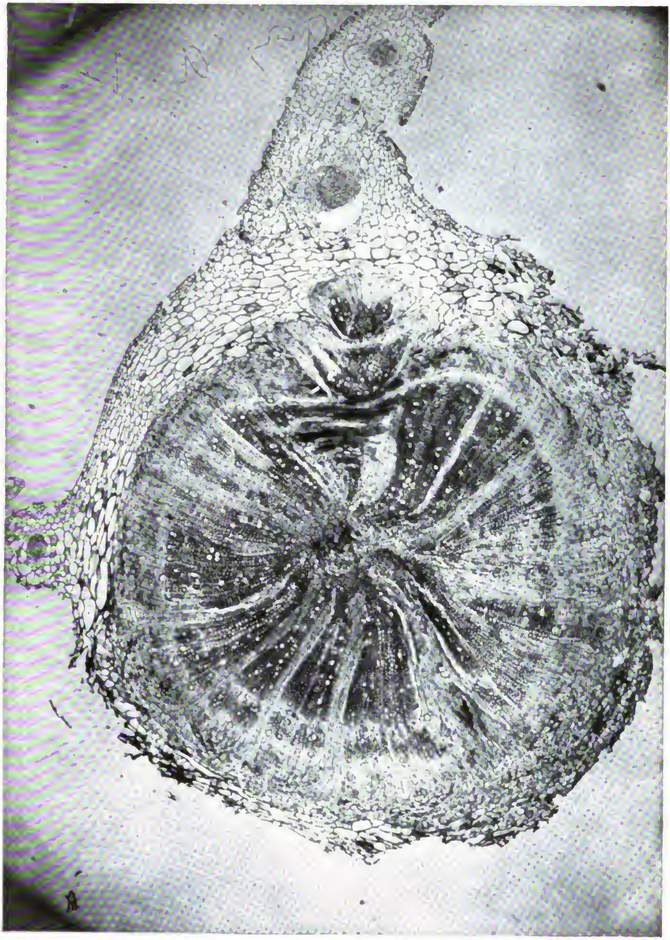


PLATE X. A CROSS-SECTION OF A LEAF STALK IN WHICH ALMOST ALL THE NORMAL CELLS HAVE BEEN EATEN AWAY BY THE CANCER (SEE PAGE 66)

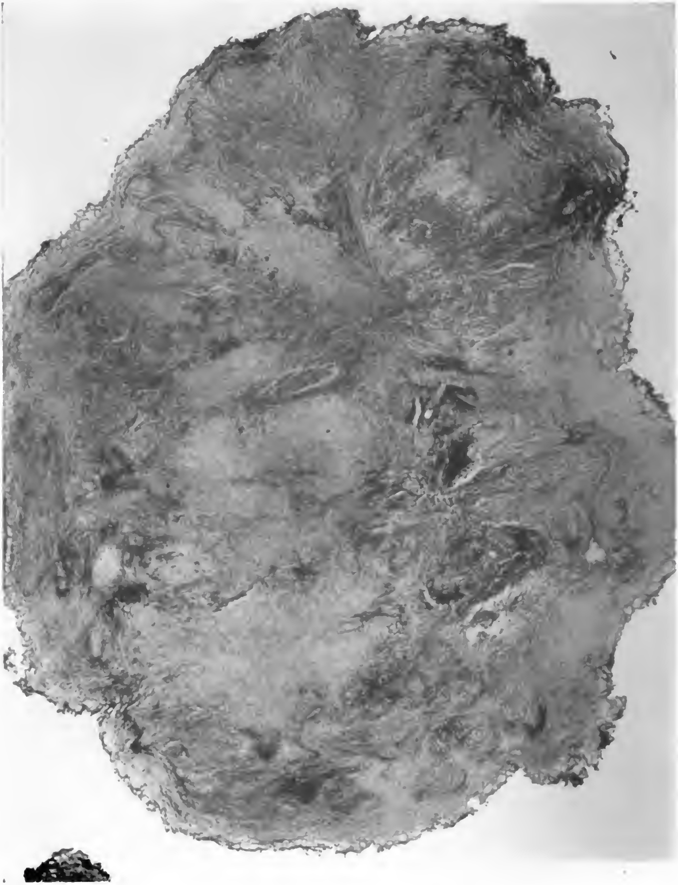


PLATE XI. CROSS-SECTION OF A LEAF TUMOR PRODUCED IN THE LEAF FROM A PURE CULTURE BY A SINGLE NEEDLE PRICK (SEE PAGE 66)

No normal cells remain; the whole body is a tumor composed of fleshy tissue and woody fiber

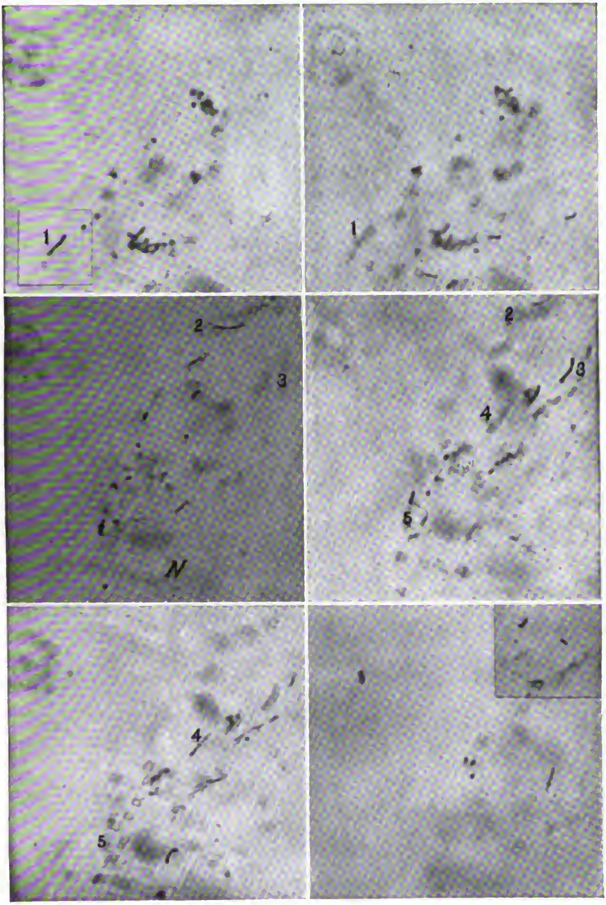


PLATE XII. PHOTO-MICROGRAPH OF EIGHT LEVELS IN A CELL, SHOWING THE ROD-LIKE ORGANISM WHICH PRODUCES PLANT CANCER, THE *Bacterium tumefaciens,* AS IT APPEARS UNDER THE MICROSCOPE

These bacteria are from a daisy tumor

by a single needle prick on a healthy leaf. Here no normal cells remain; the whole body is a tumor composed of fleshy tissue and woody fiber, the minute dots all over the picture being the nuclei of the tumor cells, from which further proliferation will take place.

It is not a simple matter to obtain photo-micrographs showing the bacteria actually in the cells, but on Plate XII we have photographs of eight different levels in a cell, and the irregular rod-like bacteria are easily distinguishable. These bacteria are described by Dr. Smith as follows: "The galls on Paris daisy are due to a white schizomycete named *Bacterium tumefaciens*. This organism is a short rod multiplying by fission and motile by means of a polar flagellum. It can be grown in many sorts of culture media, but does not live very long upon agar. It forms small, round, white colonies in agar or gelatin poured plate."

HOW THE PARASITE WORKS

The fight between the infected cell and the bacillus is most interesting, and shows how the cell responds to the stimulation and reproduces itself. This is how Dr. Smith conceives it to take place:

"The relation between host and parasite in this disease may be regarded as a symbiosis (or condition in which two dissimilar organisms live together), in which the bacterium has the advantage. The bacterium derives its food from the cells of the host and drives them at a breakneck speed. It gives to them in return its waste carbon dioxide for the use of their chloroplasts." (Chloroplasts are the bodies in the cell which contain chlorophyll or green coloring matter, and are the most important bodies concerned in the making of starch from the water in the cell and the carbon dioxide of the air.) "The bacterium does not destroy the cells of the host, but only stimulates them into an abnormal and often exceedingly rapid division.

"This stimulus, it would seem, takes place through the following delicate adjustment of opposing forces: Within the host cell the sensitive parasite produces as one of its by-products an acid. As this acid accumulates it stops the growth of the bacteria and destroys a portion of them without, however, destroying the host cell. The membranes of these dead bacteria, which have now become permeable, allow the diffusion into the host cell of bacterial endotoxines." (Endotoxines are poisons produced by the bacteria, but held within them while alive, and only escaping when the membranes of the dead bacteria disintegrate.)

THE CELL DIVIDES

"The host cell now contains, of abnormal bacterial products, (*a*) these escaped endotoxines, (*b*) a certain amount of weak acid (acetic ?), (*c*) some ammonia, and (*d*) an excess of carbon dioxide. Under the stimulus of one or more of these poisons the nucleus (or point from which proliferation commences) divides by mitosis (the usual but more complex of the two methods by which cells multiply). In process of division the nuclear membrane (the envelope inclosing the nucleus) disappears and the contents of the nucleus flows out into the cell. The dormant bacteria under the stimulus of this nuclear substance renew their activities in the daughter cells until again inhibited, whereupon the daughter cells divide. By this rocking balance, in which first the parasite and then the host cell has the advantage, the tumor develops rapidly and independently of the needs of the plant."

This rapid growth of the tumor, independently of the needs of the plant, and the tumor-strand, which produces the secondary tumors with structure of the primary tumor, show very clearly the cancerous nature of the disease, and its development closely parallels what takes place in cancer in men and animals.

Dr. Smith is very careful to point out that he considers that his discoveries have no absolutely direct bearing upon human cancer, and the following closing words are characteristic:

"Nothing in this bulletin should be construed as indicating that we think the organism causing crown galls is able to cause human cancer, but only that we believe the latter due to a cell parasite of some sort."

FROM JERUSALEM TO ALEPPO

Being the experiences and impressions of the writer while making a trip starting from Jerusalem via Jaffa and Tripoli of Syria to the Cedars of Lebanon, through the Lebanon pass to Baalbek, and on to Homs, Hama, and Aleppo, during the months of August and September, 1912, and illustrated by photographs taken specially on the trip by members of the American colony.

By John D. Whiting, of the American Colony, Jerusalem

THE chief boatman at Jaffa called out "Yalla! Yalla!" to his men, who were making their way deliberately to the large row-boat in which we were seated. The steamer was soon to leave, and the call of the chief had the result of electrifying the men, and in a few moments eight brown, muscular boatmen were pulling us through the narrow opening between the rocks to which tradition states Andromeda was chained, to be eaten by a sea monster.

These rocks have been the terror of pilgrims and tourists for centuries, but the Jaffa boatmen are renowned for their skill as well as courage and endurance.

We were now able to compose ourselves and count our packages. We had only decided after dinner the evening before to take the trip, and Mr. Larson and Mr. Baldwin, my two companions, were up all hours of the night getting ready. Yes, the pieces were there; thirteen in all.

It might seem strange for three men to need so much baggage, but the fact is we had only two small suit-cases between us, and the balance was photographic apparatus of all kinds and a couple of heavy boxes of plates.

A few hours of slow steaming brought us round the promontory of Mount Carmel, which figures so largely in Old Testament history, and which, since Haifa during the past half century has grown so rapidly in importance, has become quite a summer resort.

The sun was almost setting as the large barges were being filled and emptied as fast as possible by yelling Arabs, who can do no sort of work without exercising their lungs as well as muscles.

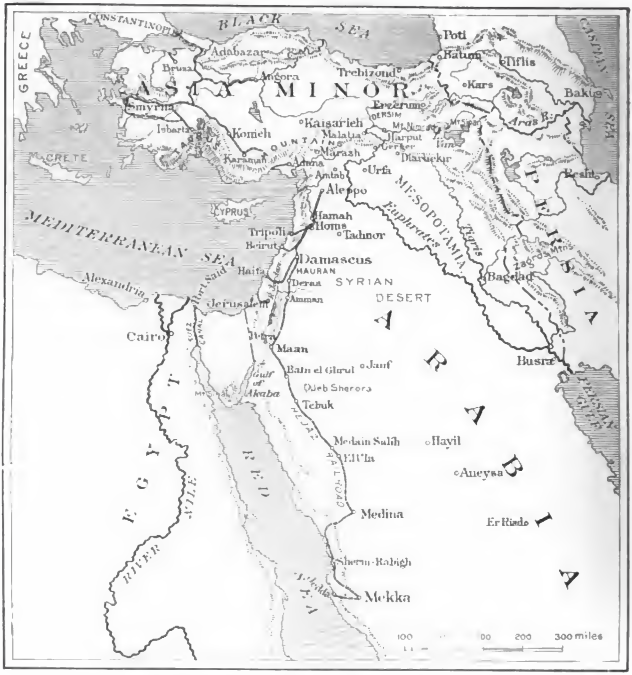
THE SYRIAN EMIGRANT

The lower decks of the steamer were packed with steerage or deck passengers, who, from the time we were nearing Beirut, occupied themselves in arranging their toilet preparatory to disembarking.

From their appearance many could have been taken for Italians, but one had only to watch a few moments to see that they were Syrians who had been seeking their fortunes in America. Suit-cases and ponderous trunks were opened, disclosing a mixture of old clothes, silk dresses, patent-leather shoes of distinctive American type, onions, garlic, bread, and the like, thrown in together with true Arab shiftlessness. Their attire and talk disclosed that they were just returning from various parts of America, and their gala dress and glad faces that they were nearing their native homes.

The entire costumes of both men and women were of the Occident, while the head-gear just donned was that of their native land, to which they had been used from their youth, until laid aside, with their Oriental costumes, when they launched out to seek their fortune in a foreign land. They are extremely proud of returning clad in a foreign costume, but few, especially of the men, want to be seen by their countrymen wearing hats.

Some landed at Beirut, while the larger portion waited to disembark at Tripoli. Some had been very successful in their enterprises and were talking of soon going again to the land of their adoption; some had made the trip back to Syria with the sole object of getting married and returning to pursue their fortune-making, while a few had been



MAP SHOWING PRINCIPAL TOWNS MENTIONED IN THE ARTICLE

entirely unsuccessful and were now planning to settle down to the simple life they had forsaken.

TRIPOLI IN SYRIA

While we were still quite a way out from the port of Tripoli a fleet of sailing boats glided swiftly out to meet us. The anchor dropped just as the sun set, and the cannon from the Crusader castle announced that the Mohammedan fast of the month of Ramadan had set in.*

Tripoli (to be distinguished from the African Tripoli), called in Arabic *Tarabulus*, is a twin city. The larger town is a little inland, nestled on the fertile plain amid a great area of orange and lemon groves, forming a sea of green, and on this account called by the natives "Little Damascus."* This town has grown so that its eastern edge has crept up the side of a low range of hills crowned by

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* The month of Ramadan is kept as a fast by all devout Mohammedans. During the entire day they abstain from food, drink, and even smoking, until sunset, when they may eat. Another meal is taken just before dawn. In the towns a cannon is fired twice—once to announce that the fast is over for the day and again as the fast rebegins.

* Damascus is noted for the verdant gardens which surround it.

RABBIS IN JERUSALEM

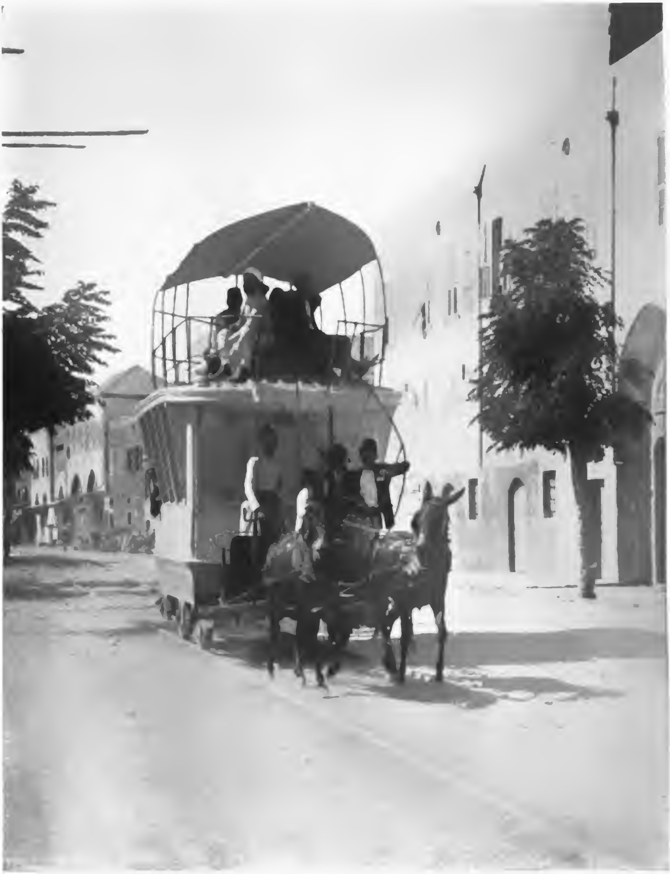
a large Crusader castle, which, at least outwardly, is well preserved and has long served as a barracks for Turkish troops.

THE CRUSADERS' INFLUENCE AT TRIPOLI

Tripoli, like most of the towns in this part of the country, has a varied history, having been first dominated by the Phenicians, and then successively by the Seleucides, the Romans, the Moslems, the Crusaders, and now the Turks.

It was during the five-years' siege, begun by Count Raymond of St. Giles in A. D. 1104, that the Crusaders built the castle that overlooks the town to prevent any relief from coming from the outside. This fortress during our visit was evacuated by the Turkish troops and the ammunition removed to a safer place further inland, in view of the war with Italy. It is a rather elongated building, the walls facing the ravine being higher and better protected (see page 79). From a Crusader's point of view, the castle could not have been better placed, but with modern artillery it would be an inviting target to a man-of-war.

The smaller town, called El Mina (the port), is located on the bay about two miles from the larger town, the space



A MULE-DRAWN STREET CAR OF CURIOUS DESIGN RUNNING BETWEEN THE TWIN TOWNS OF TRIPOLI (SEE TEXT, PAGE 75)

The traveler from the West is usually surprised to find how often the electric street car of American manufacture is found running merrily in the most unexpected places all over the East. The above type of street car is one which is rapidly giving way to the more speedy and comfortable competitor from the West.

between being a green expanse of orange orchards and mulberry trees irrigated by the mountain streams. The two towns are connected by a primitive mule-drawn street-car service (see page 74).

RAILROAD EXPANSION IN SYRIA

About a year ago a railroad was constructed from Tripoli by a French company to connect with their lines running from Beirut and Damascus to Aleppo.

Since operations have begun on the Aleppo section of the German railway line from opposite Constantinople to Bagdad, Tripoli has become an active seaport for receiving rail and railway materials, which are sent over the French line to Aleppo, thence to be reshipped to the eastern end of the line, which during our visit was nearing the Euphrates.

On the coast near the railway station is an ancient fort, built in the middle ages and called by the Arabs Burj es Seba (Tower of the Lion). Our friend the station-master, who calls himself Monsieur Khies, informed us that it was built by Cœur de Lion, but the style of architecture is Arabic.

It was one of a series of six forts built to protect the coast, only one other of which still exists, and it is in poor condition. The last one destroyed was to make room for the railway station. A petition has been sent to Constantinople, and, if granted, will also seal the doom of Burj es Seba, which, though fully worth being preserved as a relic of antiquity, is thought to be an obstacle in the way of the "iron road," as the natives say (see page 80).

The old saying, "The never-changing East," should be modified to "The slowly changing East," at least as far as Palestine and Syria are concerned. One cannot travel through these countries without constantly being struck with the intermixture of the very old and the new side by side.

THE FAST OF RAMADAN

After two full days at Tripoli, we were ready to start for our first goal, the Cedars of Lebanon. We woke while it was still dark, thinking Mohammed Ali, our muleteer, had come with the horses, but instead found it to be a man with a drum, which is beaten with a strap to awaken the sleeping fast-keepers to their early morning meal. The pealing of a cannon at this hour serves for this purpose, but it is supplemented by a number of poor men, each one of whom voluntarily canvasses a given district with a view to receiving, on the feast at the end of Ramadan, presents of food and cash.

The night was still, and the voice and drumming recalled memories of childhood when living in the Mohammedan quarter of old Jerusalem. The crier stopped before each door, repeating short sentences, alternating them by a few flaps on his drum. His verse ran something like this: "Get up to your morning meal" (flap-flap-flap). "The Prophet has come to visit you" (flap-flap-flap). "Don't be lazy" (flap-flap-flap).

Mohammed Ali came in due time, and by the light of a small oil lamp in a smoked street lantern he loaded our heavy parcels on a mule, while the cameras were put on his mount in order to be more accessible en route. His small nephew, a boy of about 12, was taken along to drive the mule, which, however, he rode when the paths were not too steep. Mohammed Ali's horses could not be said to be fine mounts, but they were good enough, while he himself made up all deficiencies by his good qualities as a muleteer. Unlike most muleteers, he admitted his ignorance of the roads; but since one of us had been over this route once before, we were not anxious.

In ascending the Lebanon range through the valley before us to Bsherreh, where we were to spend the night, we followed the right-hand side of the Wadi Kadisha (Sacred Valley) along a carriage road, availing ourselves of short cuts now and then. The scenery was most striking. The entire hillsides were carefully terraced and planted with vines, from which hung large clusters of ripe fruit, unprotected except by a low stone wall.

"AMERICAN VILLAGES" IN THE LEBANON

We had just lost ourselves in the beauty of our surroundings when, looking up, we saw a native approaching us.

He was clad in a shirt and trousers of foreign make, supported by a broad patent-leather belt. However, he wore native slippers and head-gear and he swung a heavy club in his hand. He looked at us and the grapes inquiringly, but was soon reassured, and addressing us in Arabic, asked what we were doing here and where we were from.

We were also inquisitive to learn something of his history, and took him to be one of the many natives who had been seeking their fortune abroad. So in reply to his query we said, "From the United States."

This hit the nail on the head; his face beamed as he began in broken English, "You all from United States? I American. I real citizen. I just come back for small time. I watch all those vineyards. All those grapes mine. You go up to spring, rest little; me bring plenty grapes, countrymen. You from America. Dat's my country. This country no good. America good country."

As we ascended we were continually passing beautifully located villages, most of the houses being of a modern type, large and with bright red imported tiled roofs, while a few were of old style, with low, flat roofs, consisting generally of two or three rooms built in a row, with a porch of pointed arches running the full length and surrounded by gardens of mulberry trees, with the leaves of which they feed the silk-worms.

It was evident that here was a portion of the Lebanon from which the emigration had not only been large, but also successful. It showed also how the money gathered in America was brought back here to be enjoyed. The glowing accounts of business success brought back from America enkindle in the young people of this region the ambition to repeat the experiences of their elders.

To those who have seen the miserable surroundings of these Syrians in their colonies in, say, Chicago, where they are huddled together in crowded rooms in dilapidated houses, gathering their money by peddling for large profits and spending very little, their glowing stories of their success and importance when there does not greatly appeal.

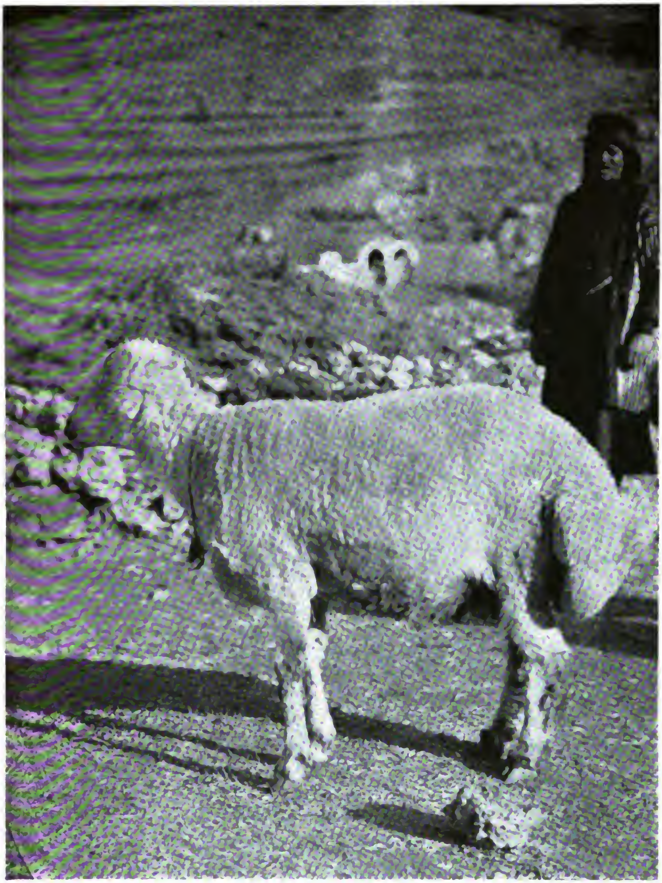
However, the natives look up to them as merchant princes, and their small fortunes avail here for much display. These "American villages" in the Lebanon, as they are sometimes called, are almost bewitching when viewed from a distance, but a nearer inspection brings disillusion. While the houses are comparatively clean, the streets are dirty and disorderly.

SOME "AMERICAN" GENTLEMEN

From Ain Sindiani the mountain slopes grew very steep and the carriage road winds up in short turns, so that short cuts are resorted to by pedestrians and animals. In crossing one of these we came upon a number of donkeys heavily laden with grapes. Their drivers were dressed in the ordinary costume of the Lebanon working class, and on their shoulders each carried a hard-wood pole about 8 feet long and 1½ inches thick, and which served the double purpose of urging on their patient beasts and of defense.

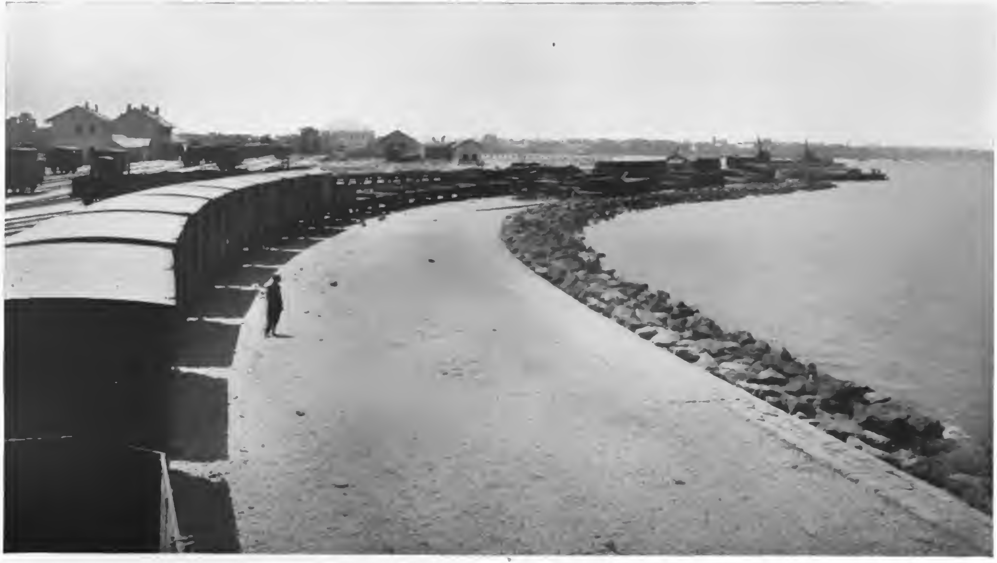
We saluted them in Arabic and found they were going over the pass above us to sell their grapes at Aineita. These in turn found out we were Americans, and one began, "I been all over America. I been to Michigan, Buffalo, and Detroit. That mighty good country. Where you from?" In reply, pointing to Mr. Baldwin, we said, "That gentleman comes from Philadelphia." "Oh!" he broke in, "you see those gentlemen," pointing to his fellow donkey drivers, clad in a sort of bloomer-like trousers reaching to about the knees, made of heavy blue cotton cloth, with tight-fitting vests, with long sleeves of the same material, over which they wore native coats of bright colors, "they come from Philadelphia. This country no good. Here walk everywhere. In America ride train, go everywhere. Donkey no good. I go back to America bye and bye. I got some properties here, for that I come back."

We outstepped the heavily laden asses and were soon out of speaking distance. We had now attained a considerable height when we noticed a number of fossils, one mass being as large as a half-bushel basket and composed of fos-



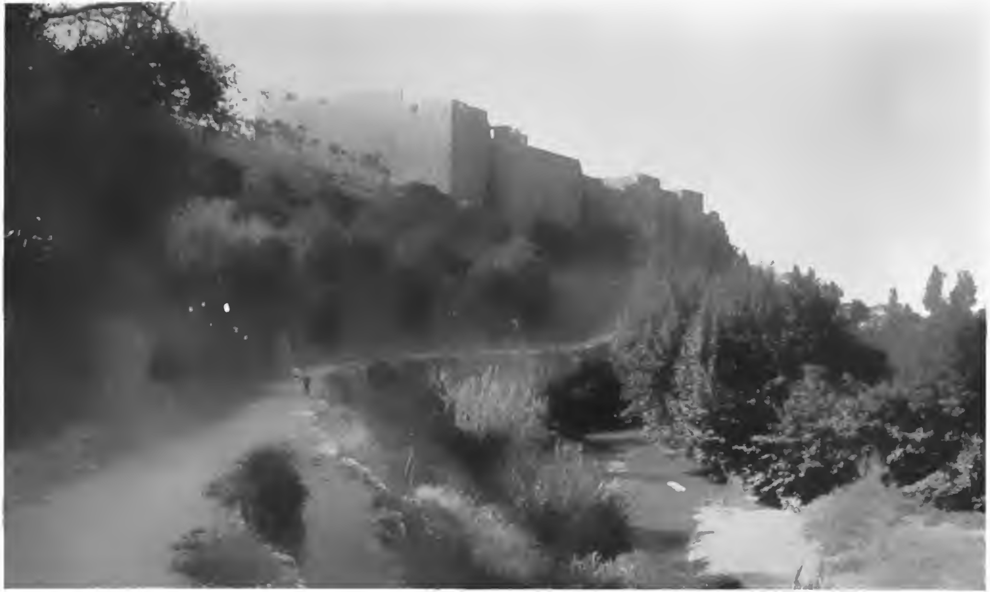
A FAT-TAILED SHEEP

These large-tailed sheep are seen throughout the Lebanon. The people fatten them excessively by forcing mulberry leaves and other food down their throats, so that their tails become of an enormous size. To such a size do they grow that they often become an impediment to the animal's movement. In these cases the natives build little wheeled trucks to which the tail is fastened, the sheep being thereby relieved of the weight, and freedom of movement is secured. Note the charm hung around its neck to ward off the evil eye.



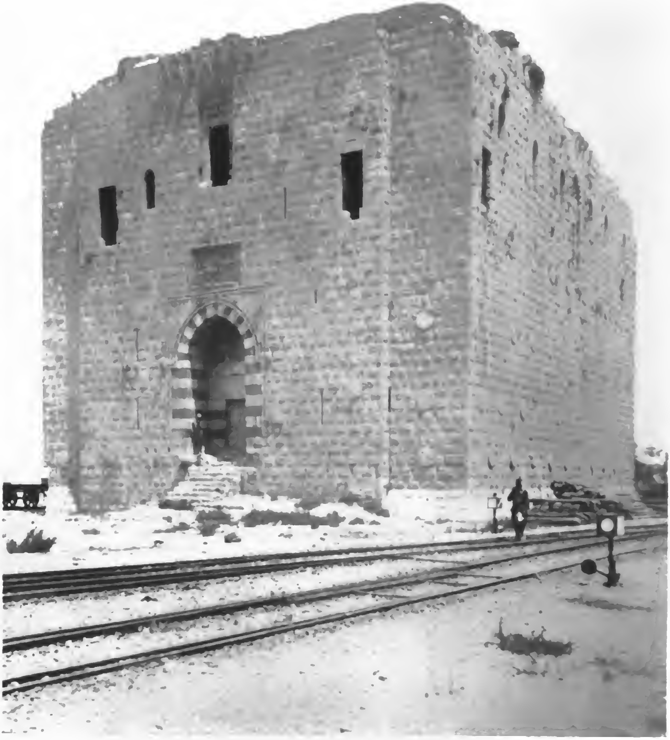
THE FRENCH RAILROAD STATION YARDS AT EL MINA, WHICH, WHEN THE BAGDAD RAILROAD IS COMPLETED, WILL CONNECT TRIPOLI WITH CONSTANTINOPLE AND THE PERSIAN GULF AND WILL RENDER IT A PORT OF CONSIDERABLE IMPORTANCE

A great deal of the material used upon the construction of the new German railroad from Constantinople to Bagdad is now imported at Tripoli and carried by this French line to Aleppo



THE LARGE CRUSADER CASTLE AT TRIPOLI, ONE OF THE BEST PRESERVED BUILDINGS PUT UP DURING THE CRUSADER OCCUPATION OF THE HOLY LAND

"It is a rather elongated building, the walls facing the ravine being higher and better protected" (see text, page 73)



BURJ ES SEBA AT TRIPOLI, A RELIC OF ANTIQUITY DOOMED TO DESTRUCTION, TO MAKE WAY FOR THE "IRON ROAD" (SEE TEXT, PAGE 75)

This fort was probably built about the year 1000 A. D. by the garrison which owed allegiance to the Fatimite caliphs of Egypt, who treated the city with great favor and made it the headquarters of a trading fleet. Local tradition makes the builder Richard Cœur de Lion, but the Arabian style of architecture proves that it was not built by any of the Crusaders. Its Arabic name, Tower of the Lion, probably accounts for the tradition regarding Richard the Lion-hearted.

silized shellfish of many forms, proving that these regions were at one time below the sea-level.

We soon obtained our first view of the cedars beyond and above us, and passed through Hadeth and Hasrun and arrived at Bsherreh before sunset.

THE PROVINCE OF LEBANON

It will be recalled that the massacres of Christians in 1860 led to European intervention, since when the Lebanon has been an independent Sanjak or province, governed by a Mushir, who must be a Christian and is appointed for five years, with the consent of the Great Powers. There is no compulsory Turkish military service, and there is a small local force of paid soldiers who do police duty. Taxation is light. Under this administration excellent roads have been built throughout the province, by which nearly all villages are reached and benefited.

During the day the valleys were obscured by a haze caused by the heat of the day evaporating the moisture below, but in the cool of the evening, by twilight, climbing the mountains quite a distance above Bsherreh, a never-to-be-forgotten view was obtained. Here nature seemed to have carved out a huge amphitheater, terrace above terrace, the upper one being that whereon the majestic cedars stand, though not then visible from our point of view. Below, in the bottom of the valley, was a deep ravine, rock-bound by high precipitous cliffs of gray limestone, which contrasted strikingly with the green terraces of mulberry and vine that extended upward, one above the other, and which broadened in so doing. On our left the River Kadisha, which rises not far from the cedars, falls in foaming cascades down into the center of the amphitheater and loses itself in a silver line in the bottom of the gorge.

Bsherreh is on the edge of a great cliff almost at the head of the valley, but a little to the left, as one looks down toward the sea. Its water-supply is an ice-cold stream flowing down from the region of almost perpetual snow.

THE CEDARS OF LEBANON

We left Bsherreh at dawn and made our way up the steep and winding road towards the cedars. In some places it was difficult to pass the loaded animals coming or going. Having made all possible haste, we reached the cedars just as the sun was sifting its first rays through the thick foliage—a sight calculated to make any heart beat faster. The grove numbers about 400 trees. With the exception of a few stragglers, the grove is inclosed by a neat stone wall to protect the smaller trees from goats. In the center is a small Maronite chapel (see page 82).

To dwellers in Syria, where forests of tall trees do not exist, these majestic cedars must be overawing. A modern Syrian writer says of them, that they are "undeniably the most lofty of all the vegetable kingdom." The fact is that they are about 80 feet high, which is more than the height of the trees of an average American forest. They are justly renowned for the size of their trunks, the girth of the largest reaching 47 feet.

A striking peculiarity of these trees is the growth of their branches, which extend straight out at right angles to the trunk and are furnished with exceedingly thick foliage, brown as seen from beneath, but when viewed from the hillsides their upper surface resembles a rich, dark-green lawn studded with cones standing erect. These latter are the size of large goose eggs.

LEBANON NOW DENUDED

In some other parts of the Lebanon there are cedar groves, but the trees are much smaller. Here we have a suggestion of what the Lebanon was in ancient times, when the now bare peaks and mountain sides must have been covered with these trees.

It was here that King Solomon's seventy thousand hewers wrought, with their three thousand six hundred overseers, besides those supplied by Hiram, King of Tyre, to get the cedar wood required for the temple at Jerusalem, and which was taken in rafts to Jaffa and thence carried up to Jerusalem. These trees were also used in the construction of David's house, and later in the building of the second temple. A white resin which they

IN THE CEDAR GROVE, SHOWING THE MARONITE CHAPEL ON THE EXTREME LEFT (SEE TEXT, PAGE 81) exude served in the ancient process of embalming.

These trees (*Cedrus libani*), called by the natives "Arz," are a local variety of a widely distributed species. The wood is cream color and works up easily, much resembling soft pine. This grove stands on a small hill situated at 6,315 feet above sea-level, and above it rises abruptly the lofty Jebal el Arz, whose summit is seldom without snow.

The Christian natives attach a sanctity to these trees, and here is held an annual feast, to which pilgrims flock from all directions. It also serves as a delightful summer camping place. At the time of our visit a number of families were encamped among the trees, including some of the professors from the American College at Beirut, who, with their families, were here for their summer vacation.

WHEN DID SOLOMON LIVE?

While sauntering through the grove we encountered the Maronite priest in charge of the chapel. He asked how we liked the cedars, and in reply we expressed our admiration, but said it was a pity there were so few left. He replied, "So they have been for 4,000 years, and history tells us that they have been just as you see them since the flood." "But," we remonstrated, "Solomon got all his timber for the building of his temple from these mountains, so there must have been many more." "It is true," he said, "that Solomon got his timber here, but that was long before what I have just mentioned." A peasant standing by, regarding with awe the wisdom of the priest, added, "You see, khawaja (gentleman), these trees," pointing to some of the smallest of the cedars, "have been growing since the days of Christ."

As we turned away we mused upon this new leaf of history, that Solomon lived before the flood, and that it takes 2,000 years for a cedar to attain a diameter of about 18 inches.

Shortly after noon we reluctantly left the cedars, as between us and Baalbek there lay 10 hours on horseback, and we wished to deviate a little from the direct road, so we pushed on so as to shorten the next day's work.

Soon we came to the very steep ascent of Jebal el Arz (Cedar Mountain), which brings one to the top of the pass 7,700 feet above sea-level, while to the north towers a higher peak, Dahr el Kodib, 10,050 feet.

Both sides of this pass were covered with a thick layer of finely crushed stone, as if a gigantic stone-crushing machine had been at work for ages. The upper part of the ascent had to be done on foot, as well as all of the descent, for the horses' feet buried themselves in this loose mass, which kept slipping from under them at every step. This road has been described as akin to those encountered in Alpine climbing.

ON THE ROAD TO BAALBEK

The view from the top was superb. Far below, to the east, lay Baalbek and the great plain on which it stands, like a raised map, terminated by the Anti-Lebanon and the snow-capped peak of Hermon. To the east, far down through the beautiful valley we had traversed, Tripoli and its bay were plainly seen, and all bathed in shades of transparent blue.

Descending to Aineita, we spent the night in the priest's house. It is a small, poor village, lying just on the upper edge of the timber-line. The houses, all but the little church and a couple of others, are built of small stones without mortar, with low ceilings and with roofs of rough timber covered over with clay to shed the rain.

The house of the priest, which might be taken as a typical one, consisted of three rooms, two on one side and one on the other, connected by a roofed court. Native mattresses were spread for us on the floor and native quilts of exceptional thickness and weight served as covers. Everything was remarkably clean, and the night we had been dreading was passed comfortably.

THE LAKE OF VENUS

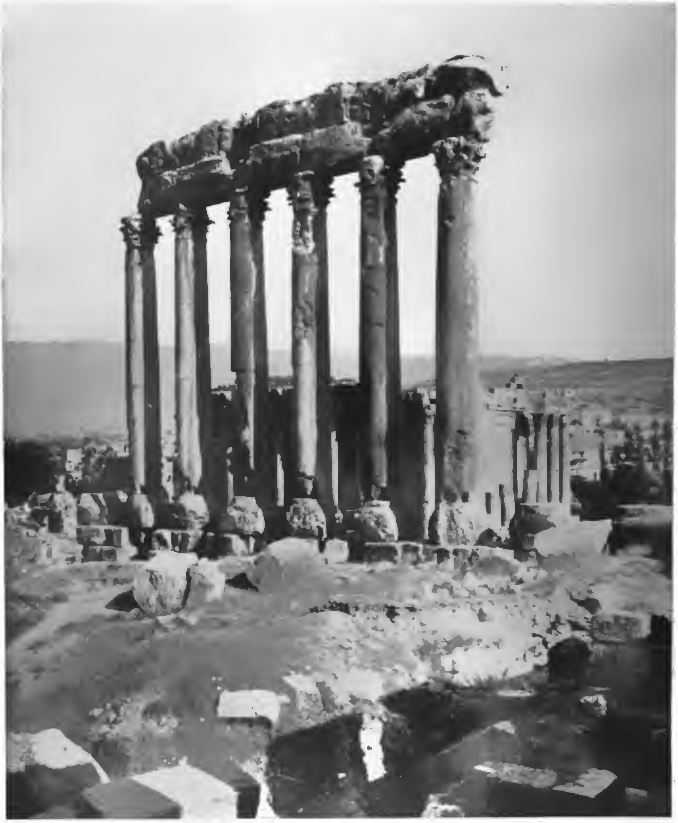
By dawn we were en route for the village of Yammouneh and the mountain lake of the same name. The latter in winter is large, but by the end of summer has dried up, even though it is fed

A TYPICAL CEDAR OF LEBANON, AS USED BY SOLOMON IN BUILDING THE TEMPLE

"And Solomon sent to Hiram, saying, . . . Now therefore command thou that they hew me cedar trees out of Lebanon; . . . for thou knowest that there is not among us any that can skill to hew timber like unto the Sidonians. . . . And Hiram sent to Solomon, saying, . . . I will do all thy desire concerning timber of cedar, . . . My servants shall bring them down from Lebanon unto the sea: and I will convey them by sea in floats unto the place that thou shall appoint me. . . . So Hiram gave Solomon cedar trees and fir trees according to all his desire" (1 Kings 5: 2-10).

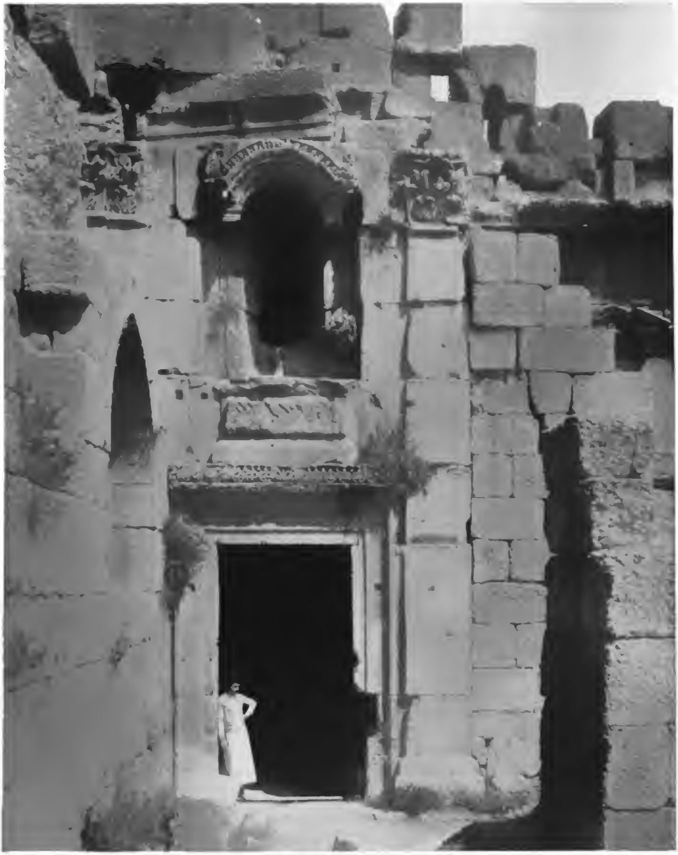
IN THE HEART OF THE CEDAR GROVE, SHOWING THE CONTRAST BETWEEN THE OLD AND YOUNGER TREES

The big tree in the center, while not the largest, is one of the oldest. These trees were much admired by the Crusaders, who attempted to introduce them into Europe. Some of these efforts were successful, and at Warwick Castle, in England, there are still some famous old cedars planted by one of the crusading earls of Warwick nearly 800 years ago.



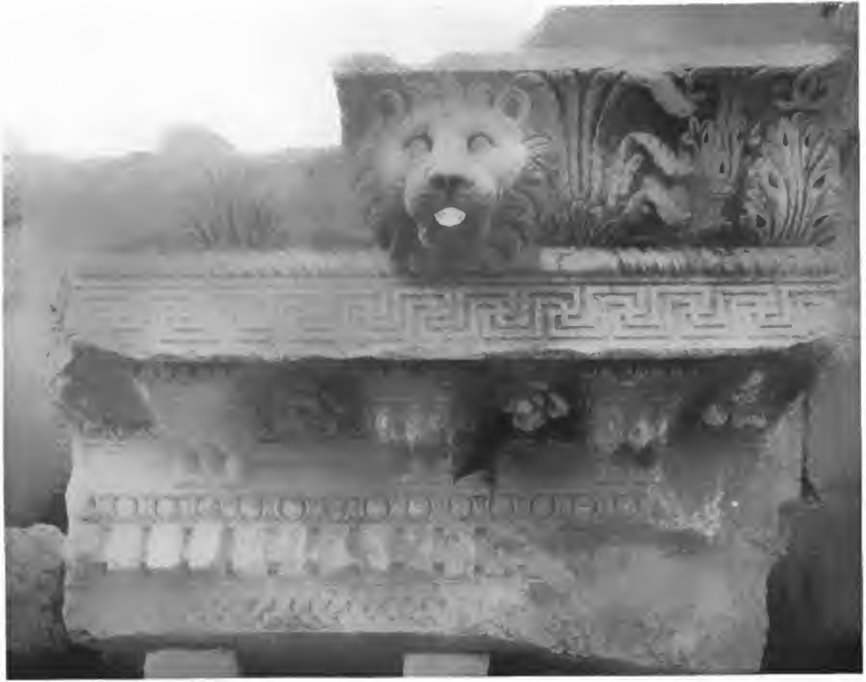
THE SIX PILLARS THAT REMAIN OF THE GREAT TEMPLE

"These lofty pillars do not taper as they appear to do when seen from below." Behind the pillars is seen the Temple of Bacchus. The Great Temple was dedicated to Jupiter, identified with Baal and the Sun, and with him were associated both Venus and Mercury, under whose triple protection the ancient city of Heliopolis was placed. The extreme license which marked the worship in this temple is often referred to by early Christian writers (see text, page 99).



ONE OF THE DOORWAYS LEADING FROM THE GREAT COURT INTO A SMALL ROOM WHICH MAY HAVE BEEN FOR THE USE OF THE PRIESTS: BAALBEK

The ruins at Baalbek were first visited in modern times in 1507, by a German, Martin von Baumgarten, and again, in 1555, by a Frenchman, Pierre Belon, who wrote two books upon the subject. Much damage was caused by an earthquake in 1759, the disorder then occasioned remaining till 1901, when the German Archeological Institute intrusted the work of clearing and excavating to an expedition headed by Professor Puchstein, under whom admirable work has been done.



A SECTION OF THE FALLEN CORNICE OF THE GREAT TEMPLE: BAALBEK

A tall man standing on a level with the bottom of this fragment barely reaches the lion's mouth. In all, the entablature is 17 constantly by numerous springs around its shores. There is no visible outlet.

The natives account for this in various ways. Some of them say that the water finds its way by a subterranean passage to the other side of the mountain range, where it flows out, forming the spring called Afka. They base this theory on the fact that the fountain increases its flow and also diminishes and ceases its flow simultaneously with the lake.

On the shore of the lake is a ruin, consisting of large blocks of drafted stones, which is said to be the remains of a temple of Venus. Local mythology claims this as the lake in which Venus, when pursued by Typhon, changed herself into a fish.*

Shortly after leaving Aineita until we struck the Plain el Bika (the ancient name being Cœlesyria), the broad valley between the Lebanon and Anti-Lebanon, these mountain slopes were covered with forests of wild oak, juniper, almonds, and pears. The latter were full of fruit, and a proportionate number of small stones lodged among the twigs, thrown up by youngsters in their attempts to bring down the fruit.

The forests are now denuded of about all their tall, straight trees, and those now left are short and gnarled. Seen from a distance, this low range looks black in comparison with the higher ridge, which is bare of trees and therefore called in Arabic Ras el Akrah (the Bald Head).

THE WONDERFUL RUINS OF BAALBEK

From these forests to Baalbek on the other or eastern side of the plain there was little of interest, except large herds of camels and their young, until we came to the column of Yaat, which is an isolated shaft 65 feet in height, composed of 16 drums of limestone crowned with a Corinthian capital. Traces of an inscription can be seen near the base, which, however, does not disclose its secret, and one can only guess why and by whom it was built.

A half hour's ride to the southwest brings us to the world-renowned ruins of Baalbek, an adequate description of which would fill a volume.

These ruins, properly speaking, are known as El Kalla (Citadel) and are composed of only two temples, and they do not cover a large area when compared with other ruins in Syria. They are, however, unique in their massiveness and in the great amount of both bold and delicate carving with which they are adorned, of which there is so much and in such variety as to make one's first visit quite bewildering.

Since these temples were built on a flat plain, it was important to raise them above the surrounding level to render them more imposing, and to that end there are vast substructures of vaults and passages supporting these shrines.

THE GREAT TEMPLE

The Great Temple, or the Temple of Jupiter, as it is called, had its main entrance from the east. Here a wide flight of steps led up to the propylæa, 19 feet above the gardens and orchards that now surround the ruins. This portico was open to the east the full width of the stairs, and the worshipers used to enter between rows of columns, on the bases of three of which are inscriptions stating that the temple was erected to the "great gods" of Heliopolis by Antoninus and Caracalla. At an early period the Arabs converted these temples into a fortress, and to a certain extent remodeled them. The columns mentioned were removed, the staircase taken up, and the material used to construct a solid wall where the columns had been.

Next came the hexagonal forecourt, entrance into which was made by means of a central doorway, with a smaller one on each side. This small court was surrounded by a colonnade, and on four of the six sides by exedræ. The Arabs have also blocked this three-fold entrance and converted the exedræ into fortifications, filling them with brick masonry.

WORK OF THE GERMAN ARCHEOLOGISTS

Since the visit of Emperor William to these ruins, in 1898, a body of German excavators were sent to Baalbek, who worked here from 1901 to 1904, and

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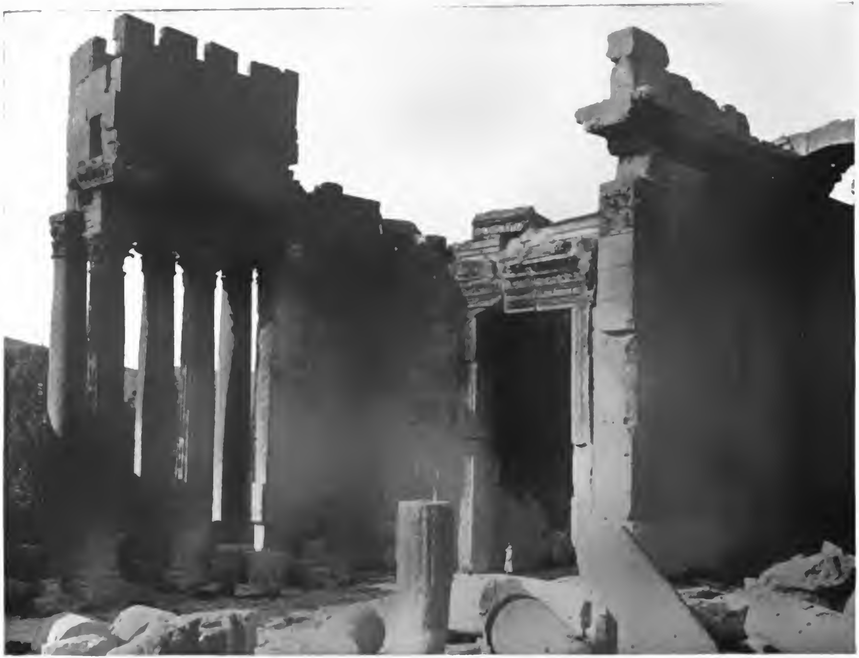
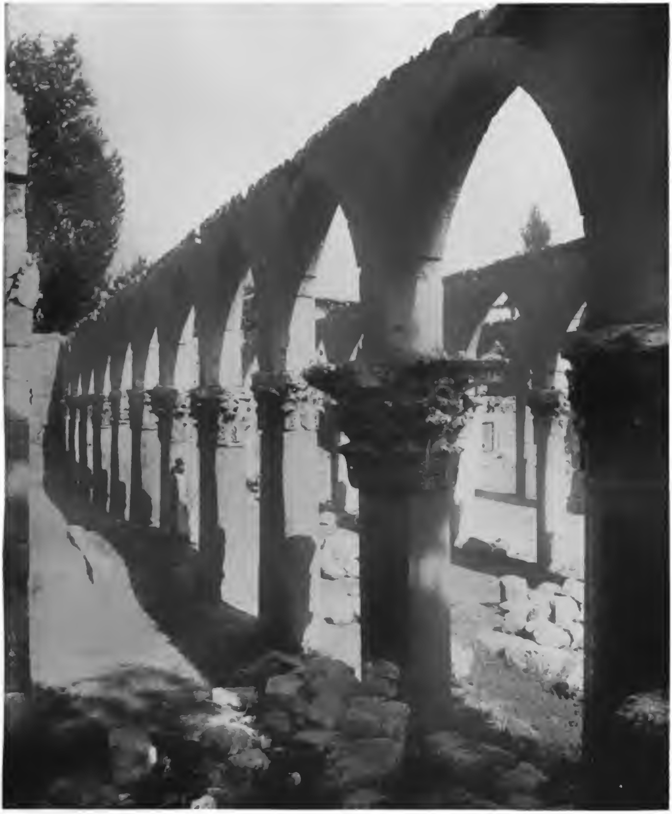
* History of Baalbek. Michael M. Alouf.

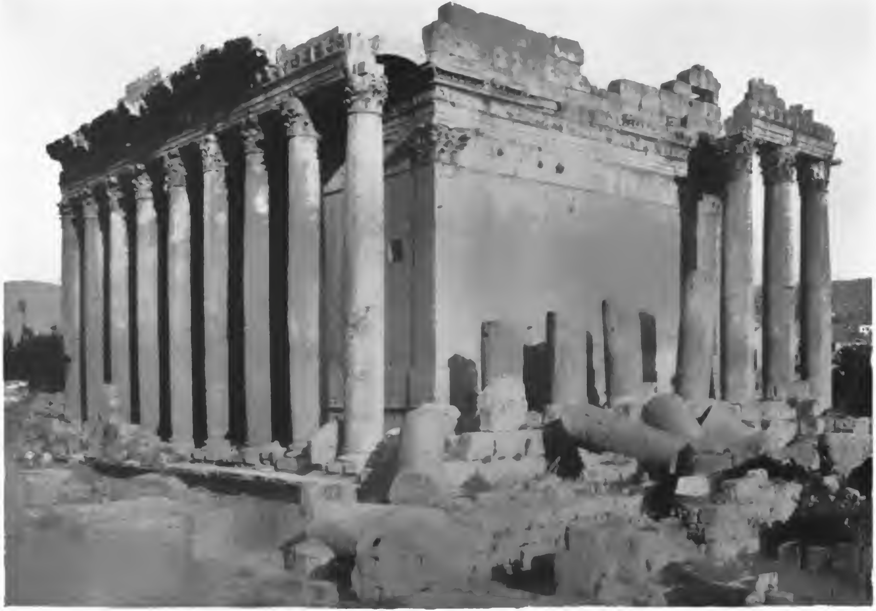


VIEW OF THE FRONT END OF THE TEMPLE OF BACCHUS. NOTE THE ARABIC FORTIFICATION BUILT ABOVE THIS TEMPLE.
SOME IDEA OF THE SIZE OF THE GREAT PORTAL CAN BE OBTAINED FROM THE FIGURE STANDING BENEATH IT

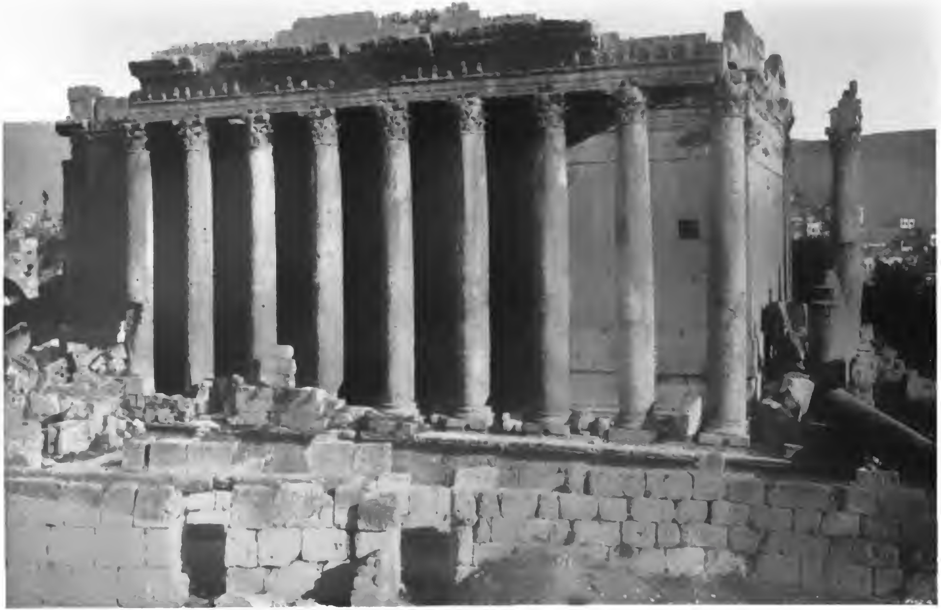


RUINS OF ONE OF THE MOSQUES AT BAALBEK, BUILT OF ANCIENT MATERIALS FROM THE TEMPLES

Although the population of Baalbek now numbers only about 5,000, it was in the middle ages a flourishing and well fortified Moslem city, which was visited and described by the Arab geographer Abulfeda, Prince of Hama (see page 109). The mosque shown above probably dates from the reign of Sultan Kalaun (1282). So well fortified was Baalbek that, while the Crusaders raided the valley several times, they never succeeded in taking the city.

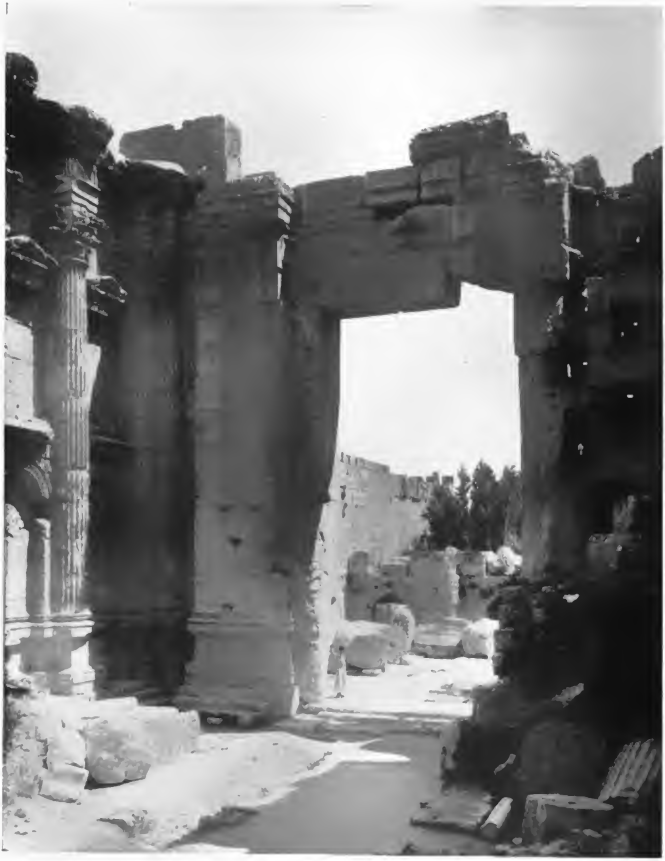


TEMPLE OF BACCHUS: VIEW FROM THE DIRECTION OF THE GREAT TEMPLE (SEE TEXT, PAGE 90)



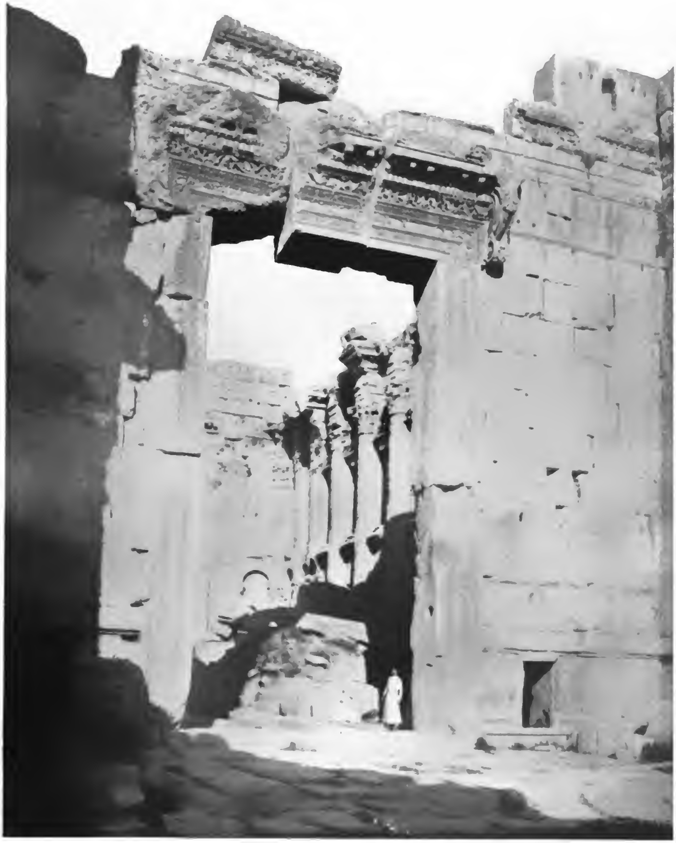
ANOTHER VIEW OF THE TEMPLE OF BACCHUS: BAALBEK

Note the native standing on the left, near the last column, by which some conception of the size of the ruins can be had. Note also the height of the entablature (see text, page 99)



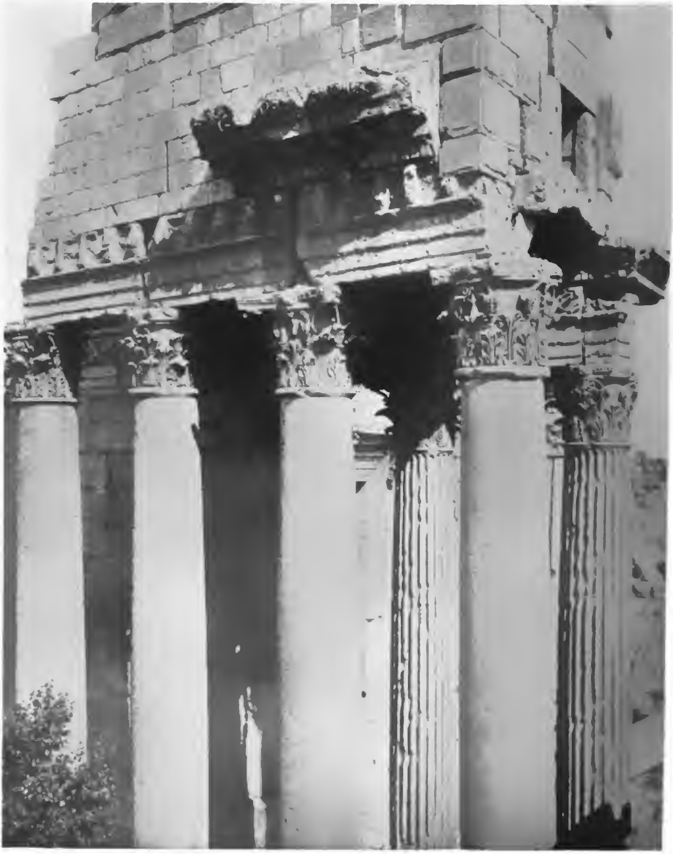
LOOKING OUT THROUGH THE GREAT DOORWAY, TEMPLE OF BACCHUS

The native in the doorway supplies an approximate scale of measurement. Note how, through the cleavage of the inside face of the door post, to the right, the winding stairs leading to the top of the building are exposed.



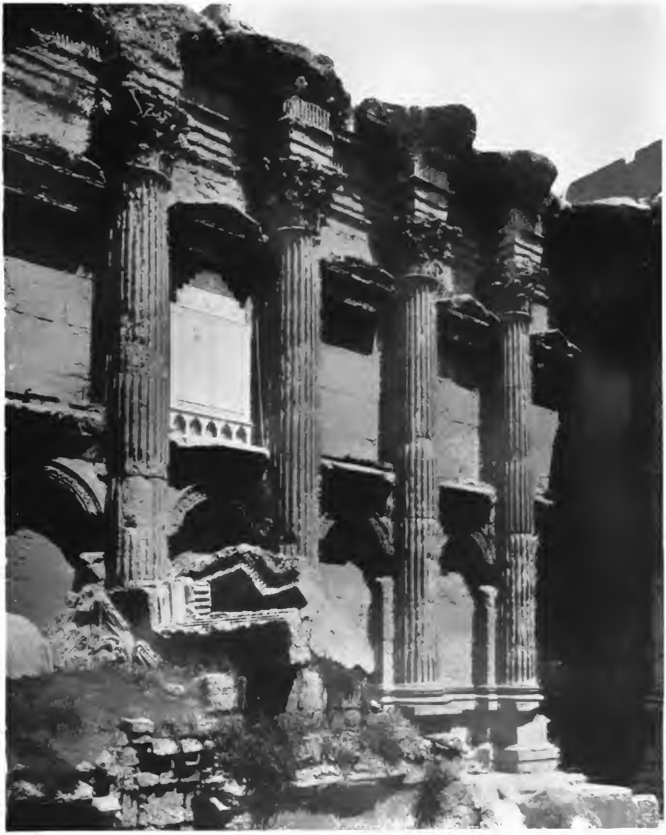
THE GREAT PORTAL INTO THE TEMPLE OF BACCHUS (SEE TEXT, PAGE 101)

The view of this exquisite portal was long obstructed by an Arab screen in the vestibule. This was removed by the famous orientalist, Sir Richard Burton, when he was British consul at Damascus, in 1870. He also propped up the cracked door-lintel, which has since been more firmly secured by the German archeologists.



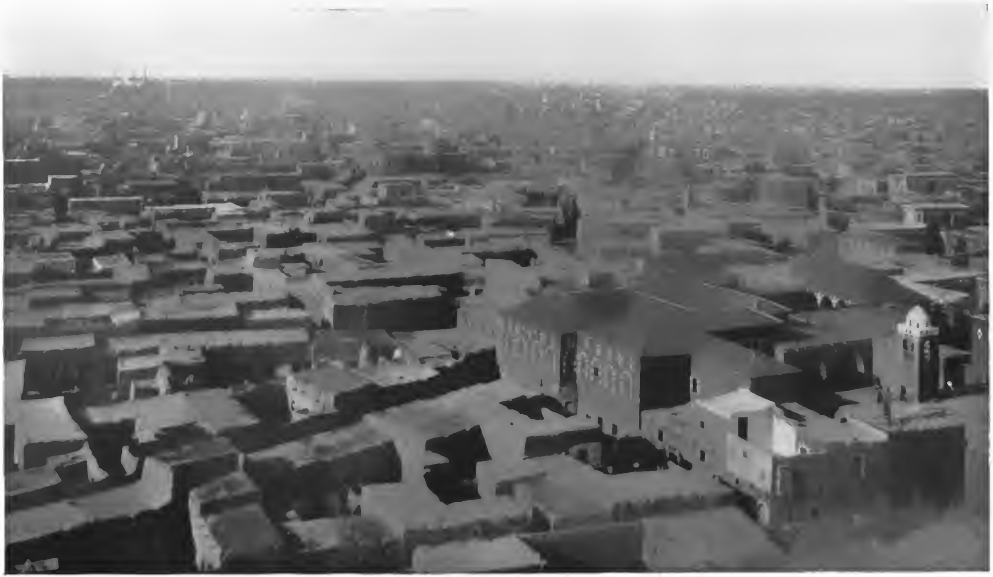
EXAMPLES OF PLAIN AND FLUTED COLUMNS, TEMPLE OF BACCHUS

Note the great doorway seen between the columns. The structure at the top of the picture is the remains of the Arab fortification, which is also shown from the other side in the picture on page 90 (see text, page 101).



INTERIOR OF THE TEMPLE OF BACCHUS

On the wall to the left is a tablet in late Arabic art, put up by the Turks to commemorate the German Emperor's visit in 1898. The modern and ancient styles of art may rudely clash; but as the visit resulted in the expedition under Professor Puchstein, it well deserves commemoration (see text, page 89).



GENERAL VIEW OF HOMS

Note examples of poorer and better styles of houses in the foreground. One of the square minarets mentioned in the text is seen in the right foreground every visitor owes them a debt of gratitude. They not only dug down and removed the debris, but strengthened weak parts, and, where necessary, they have removed the Arabic work so as to make the original plan more easily comprehensible to the visitor. However, it was not entirely a disinterested work, for the Berlin museums now possess many of the finest examples of the carvings found here.

The workmen built a narrow staircase where the broad old one used to be, have torn away the wall constructed over the bases of the columns, and have opened an entrance through a great block of stone which was placed across the central doorway into the forecourt, so that today we enter again as did the Roman worshipers of old.

Proceeding inward we pass through a triple entrance into the Great Court, or Court of the Altar. It is about 440 feet long by 370 feet wide. The central portal, as well as one of the smaller side ones, has fallen in, and the pieces which formed the arches have been collected and laid together on the ground below the place where they had originally been.

Around this court, on three sides, omitting the west end, where a staircase led up to the level of the Great Temple, are square and semicircular exedræ, each of which contain many handsome niches for statues, of which, unfortunately, not a single example remains. These were designed as resting places for the devotees who came here to worship. In front of these exedræ ran a colonnade of polished Egyptian granite surmounted by an entablature bearing carvings of rare beauty. The columns have all fallen and now with fragments of their entablature and capitals lie about the court.

HOW THE CHRISTIANS USED THE TEMPLES

In the center of the court, rather nearer to the steps ascending to the temple, stands what is left of the large altar. On each side of it is a pool or basin used for ablution in connection with the religious rites here observed.

When these temples were taken possession of by the Christians, a church was erected over this altar, part of which was destroyed, and then the space leveled up with the earth so that the church floor was above the top of the altar; so, also, the lower part of the staircase was filled over, while the upper part was removed to accommodate the apses.

The construction of this basilica is attributed to Theodosius, Roman Emperor of the East, who reigned towards the end of the 4th century of our era. The Great Temple was demolished to furnish materials for the construction of this church.

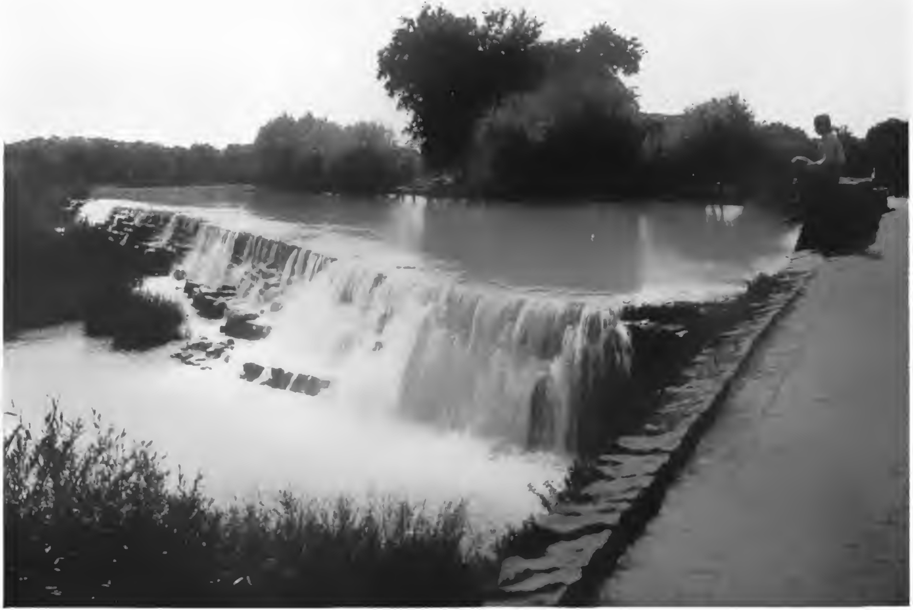
The idea was to obliterate heathenism by placing this Christian shrine right in the center of this renowned temple of the heathen gods. As it seemed to work in best, the apses were placed as above described on the west, with the entrance from the east. Later this was considered unorthodox, and an apse or apses were built at the west end, so that now traces of them appear at both extremities of the ruins.

The Great Temple itself has been almost entirely destroyed. All that is left are six columns of the peristyle, still standing *in situ*, capped with Corinthian capitals and joined by ornate and massive entablature. These lofty pillars do not taper as they appear to do when seen from below (see page 86). They are over 60 feet high and 7½ feet in diameter and are each composed of three drums. The deep entablature is also in three layers, the uppermost, or cornice, having a gutter cut in its upper edge to receive the rain water from the roof, and at intervals mammoth lion heads with open jaws serve as spouts. In all, this entablature measures 17 feet in height (see page 88).

THE TEMPLE OF BACCHUS

One can perhaps best mentally reconstruct the Great Temple by an inspection of the smaller one, dedicated to Bacchus, which lies to the southeast of the Great Temple, entirely independent of it and on a lower level (see pages 92 and 93). It had no court, but was entered by a flight of steps from the east.

The walls of the cella, which is oblong, are quite plain on the outside and are built of carefully dressed stone, the



THE RIVER ORONTES AT HOMS

The name Orontes was used for this river in classical times, and it has also been known as the Draco, Typhon, and Axius. It is mainly unnavigable, and is of little use for irrigation; but the valley through which it flows has long been a highway of North and South Syria.

joints so perfect that a knife-blade cannot enter between. Around this at a distance of 10 feet runs on the two sides and ends a row of smooth columns which forms the peristyle.

These, including their capitals, are about 52 feet high and are surmounted by a magnificent entablature. This entablature is connected with the walls of the cella by enormous slabs of stone, which are elaborately carved with the heads of emperors, deities, and interwoven with floral designs, forming an exquisite ceiling.

While the walls of the cella are still perfect, more than half of the columns forming the peristyle have fallen, the north side being the best preserved. Notwithstanding the profuse ornamentation of the peristyle, it is exceeded by that of the portal to the temple, which is indeed the gem of the entire edifice (see page 95).

The door posts are elegantly carved with figures of Bacchus, fauns, cupids, satyrs, and bacchantes, woven around which are grape-vines and clusters of fruit, also poppies and ears of wheat, all of which are symbolical of the attributes of the revelling god to whom the temple is dedicated.

This great doorway stands 43 feet high and 21½ feet wide, while the carving of the posts just mentioned covers a space about 6 feet wide. On both sides of this door stand graceful fluted columns, forming the prostyle or portico, while the plain ones of the peristyle, which stand behind them, seem to reflect their beauty.

The decorations of the walls of the interior of this temple resemble the carvings of the exedræ of the Great Court, having two rows of niches for statues one above the other and divided perpendicularly from each other by engaged fluted columns.

As already mentioned, these temples stood on a raised platform resting on substructures. The Great Temple lies 44½ feet above the level of the plain and is the highest part of the entire inclosure, while the Great Court was only 23 feet lower.

THE ENORMOUS MONOLITHS OF BAALBEK

An inclosing wall, the mammoth stones of which have been the marvel of engineers for ages, deserves mention. The lowest courses are built of stones of moderate dimensions, but which grow rapidly in size until we come to a row of three enormous stones, the shortest being 63 feet and the longest 65 in length, and each being about 13 feet high and 10 feet thick. The course of which they form part is some 20 feet above the surface of the ground.

They are the largest building blocks ever known to have been used by man; and a still larger one lies in the ancient near-by quarry, never having been detached from the rock beneath. This one is 70 feet long by 14 by 13 feet.

In addition to the Acropolis, as the ruins described are called, there are at Baalbek several other objects of minor interest, such as the Temple of Venus.

At the hotel in Baalbek we met an interesting Turk. He was traveling, being sent out by a newly established department of agriculture at Damascus, with a carload of American and European farm machinery for sale or exhibition to the peasants. He had a very clear conception of the reforms needed to aid the agriculturist in Turkey, and his eyes snapped with delight as we drew from our scanty knowledge of what the Department of Agriculture at Washington had done for our American farmers.

A short train ride northward from Baalbek, first through a flat valley which broadened into a plain, brought us to Homs, a town of some 60,000 inhabitants, located on the banks of the River Orontes, which here flows far below the level of the plain, so that the town lies cradled, invisible to one approaching it, until almost upon it.

A large mound rises to some height above the level of the valley, on which at one time stood the citadel of the town. The houses are built of unbaked bricks and have flat roofs, with some better edifices constructed of black basalt decorated with white limestone. There are numerous minarets, but very unlike the ordinary type. They are square and do not taper upward, and instead of a balcony arrangement for the muezzin, or caller to prayer, a window is provided on each side, the top terminating in a sort of dome.

THE UBIQUITOUS ADVERTISEMENT

Homs, the ancient Emesa, which has a varied and interesting history, today gains its living as a market for the large Bedouin tribes of the adjacent country. The bazaars remind one quite a good deal of Damascus, as one wanders through them, seeing here a man working a primitive hand loom, on which he turns out bright fabrics for which Homs is noted, and there a small spice shop, and again a dyer, with hands stained dark with indigo, hanging up his wet cloths in the street.

When we had lost ourselves in these strange surroundings, which seemed to place civilization at a remote distance, our eyes were struck by a placard, on which appeared in bold English "Use Fel's Naptha Soap."

On the outskirts we came across numerous potters' shops, where large water jars, some 20 inches high, were being turned out by ancient methods. The plain ones retailed at 2½ cents each, while those striped with bands of red and otherwise decorated sold at double this price. Further on were extensive threshing floors, where the grain was being threshed out with appliances that have probably been in use for thousands of years.

Here we also found limekilns, the fuel being a common pricker that grows in the wheat fields and which has to be collected and transported from a distance requiring two to three hours' travel (see page 103).

We were often told that we would find the people of Homs and Hama very fanatical and anti-European, but our experience did not bear this out. We found them very polite and not averse to being photographed.

Moreover, we never heard the familiar word "bakshish," the only person who asked for a tip being a tired native woman, who had been carrying bunches of thorns all day to the limekiln, when she was asked to hold her bundle up while a picture was being taken. When the money was handed her she seemed to be ashamed of herself and only took it after much persuasion. The secret lies in the fact that they have not been spoiled by Europeans.

If you want to see the Arabs at their best, take them where they have not been tainted by outside influence, for, like most primitive peoples, they more readily take on the vices than the virtues of civilization.

A TEST OF KEEPING RAMADAN

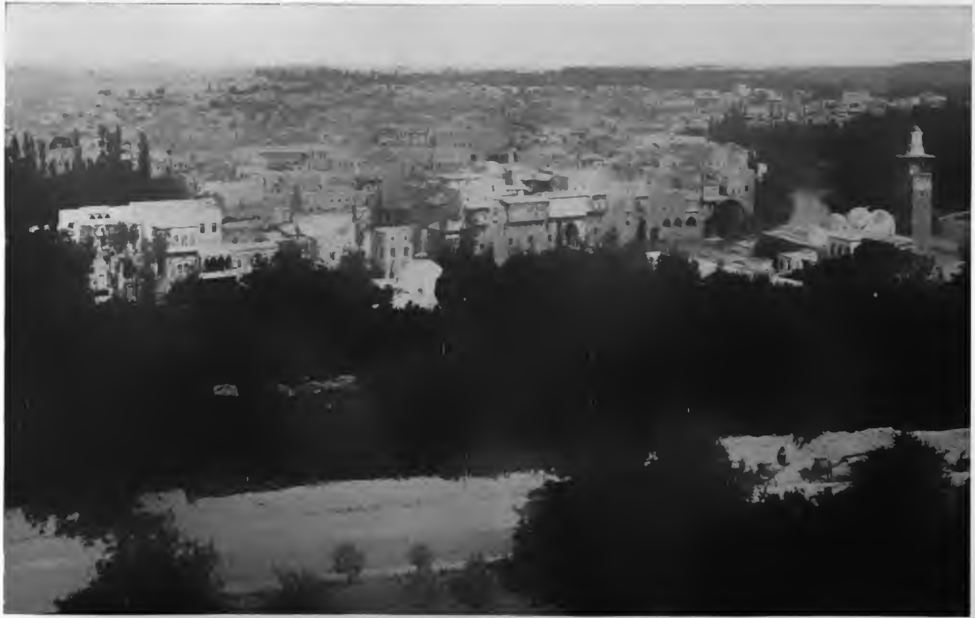
On our return to the town we were stopped by a native, who seemed to be a friend of our carriage driver and who asked him if he was keeping the fast. The driver replied that he was. "Then," answered the friend, "by Mohammed, the prophet of Allah, show me your tongue." The driver produced that member and the questioner used both hands to draw the jaws open wider in order to complete his examination, after which he turned away, shaking his head with a kind of unexpected satisfaction, muttering to himself, "By Allah, he is really fasting" We said nothing, for not long before we had seen him, while waiting for us, go into an obscure corner to satisfy his hunger with some bread he had with him.

Curious windmills are to be seen here on the tops of some of the houses. Round disk-like pans of sheet-iron are fastened to wooden arms and are so disposed that the wind striking them causes them to revolve.

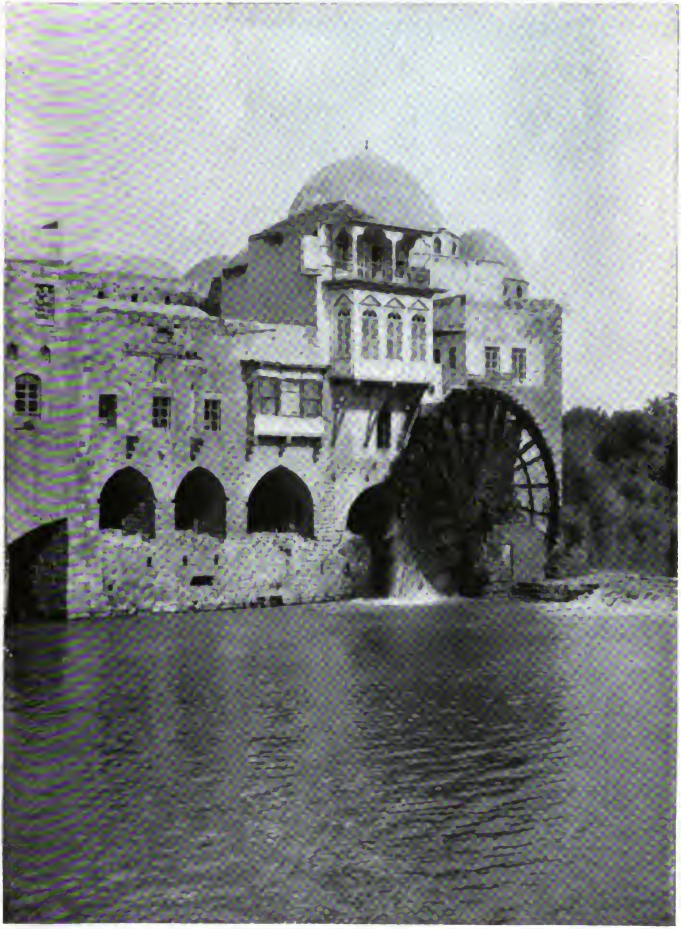
A curious custom also obtains of ensnaring domestic pigeons. Our attention was called to it by seeing a man on his housetop swinging round over his head what resembled a huge tennis racket, only instead of the tight strings a loose bag was attached to the frame. Over him hovered a large flock of pigeons. We were told that his own pigeons decoyed others which followed and were caught. After being taken, if they proved to be the property of a friend they were returned, but if of an enemy they were kept. They did not regard it as stealing,

A NATIVE LIMEKILN

Large tracts of Syria are completely destitute of trees, and consequently anything in the nature of fuel is exceedingly scarce. Often the only tree to be found is a small, scrubby thorn bush, which nevertheless has its value. The woman shown in the picture had collected fuel for this limekiln at a distance requiring between two and three hours' travel.

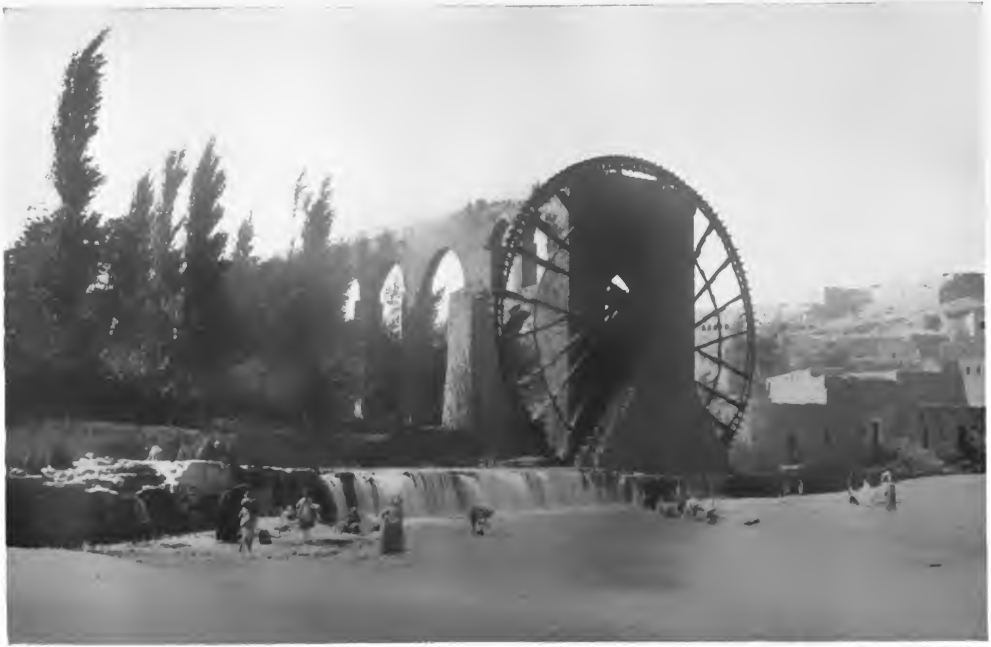


GENERAL VIEW OF HAMA: NOTE THE WATER-WHEEL ON THE MIDDLE-RIGHT OF THE PICTURE

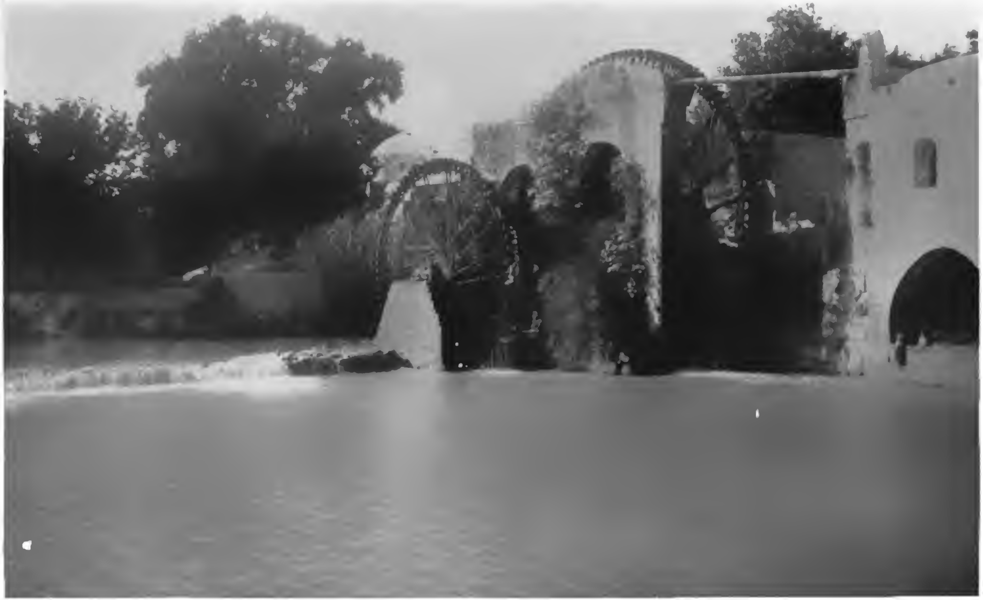


WATER-WHEEL AT HAMA CALLED "NAURAT EL KELENEY"

These water-wheels, which in working make the most curious and discordant noise, not unlike a brass band in which every instrument is out of tune, not only serve to supply the town of Hama with water, but they also irrigate the adjacent gardens (see text, page 109)

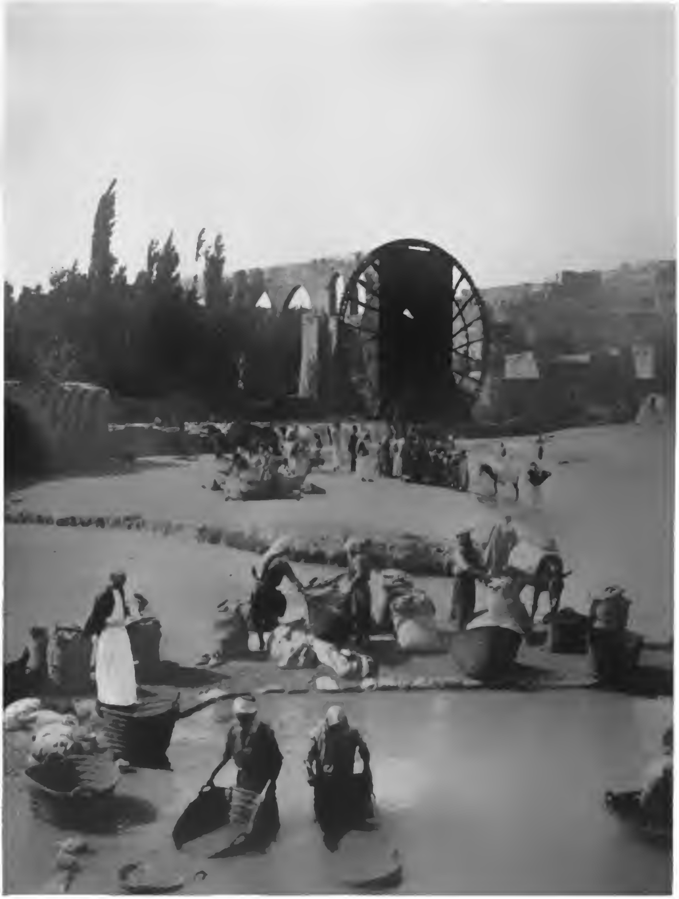


THE LARGEST "NAURA" AT HAMA, ABOUT 75 FEET IN DIAMETER; NOTE THE ARCHED CONDUIT, WHICH CARRIES THE WATER TO THE GARDENS



A DOUBLE "NAURA" AT HAMA

The largest is about 60 feet high. They are driven around by the swift motion of the river, while small buckets on the rim take the water up. Note the boy dropping back into the river after having gone up part way (see text, page 111)



NATIVES OF HAMA WASHING WHEAT IN THE ORONTES

It is then parboiled and ground in mills, making "borghal," which is the chief food of this region. The women shown in this picture are all peasants and do not veil their faces but viewed it from the same standpoint as the Bedouins, who raid their neighbors for what they can get from them, as long as they are not friends.

HOW THE ORONTES GETS ITS ARABIC NAME

The country over which we passed after leaving Homs was at times quite level and free from rocks, planted in watermelons and yellow corn; then again it would become quite rocky and covered with boulders of tufa; and still again, as we neared Hama, level and rich with extensive vineyards. The fallow ground was as if sown by nature's hand with countless wild holly-hocks in bloom. At times the road ran quite near the edge of the Orontes, whose turbid waters flowed along many feet below the level of the surrounding plain.

It is called in Arabic "El Asi," which means stubborn or unwieldy. We asked a native why this name was given to the river, and he gave the following explanation: "A Jew once filled a bottle with water from the 'Sea of the Nile' (the Arabic name for the Nile River) and came to this country to perform magic with it. Our Lord Ali* met him and asked what he had. The Jew denied that he had anything, but when hard pressed, he threw the bottle against a rock and a river issued forth. Our Lord Ali bade it stop, but it would not, and so he named it El Asi." A fellow-passenger questioned if this were an actual fact, to which our informant replied that a look at the color of the water proved it, for it was exactly like that of the Nile.

Finding our friend communicative, we asked him what use this corn was put to which here grew so plentifully, but was not known in Palestine. Opening his capacious jaws and gesturing with his fingers, he answered, "To eat; and when the loaves are hot they are mighty good, but when cold it would take one of Ibrahim Pasha's cannon to force it down one's throat."

THE HOME OF THE ARAB GEOGRAPHERS

Shemsi Bey, to whom we had a letter of introduction, met us at the station at Hama and took us to his home, where we were guests during our stay. After a sumptuous repast, we began our inspection of the town. It much resembles Homs, and like it is located on the Orontes, has a mound crowned by a citadel, and cannot be seen until one is right upon it.

Like every part of this region, Hama has a checkered history. It is first mentioned by the prophet Amos as "Hamath the great" (Amos 6:2). A small mosque called Jami el Haiya (Mosque of the Snakes), so named from its two intertwined columns, contains the tomb of Abulfeda, Prince of Hama, whose geographical work is still renowned. Under his rule Hama prospered until his death, in A. D. 1331.

The famous Arabian geographer, Yakut, is said to be a native of Hama, and while we were there we heard of a manuscript written by him which is in the possession of one of the rich families of the town.

If one would know the full beauty and picturesqueness of Hama, let him climb to the top of the citadel hill, and around will be spread out a scene which cannot be outdone in Syria. An Arabic proverb says that three things make the heart of man glad—water, vegetation, and beautiful faces. Here we have the first two, and other features in combination, whose value is enhanced by contrast with the arid lifelessness of the country which surrounds it, for at the time we were there the wheat fields were all harvested and bare.

THE WATER-WHEELS OF HAMA

The Orontes flows through the town and drives the large water-wheels, here called *naura*. They serve not only to supply the town with water, but also irrigate the adjacent gardens. We had long before heard of these singular wheels, and in fact had seen similar ones at Antioch. As we began the ascent of the citadel hill, creaking, groaning, and other weird sounds reached our ears. It at first suggested a pipe-organ, then a brass band practicing, and it was not until, after a little time, the top of one of them came into view that we realized

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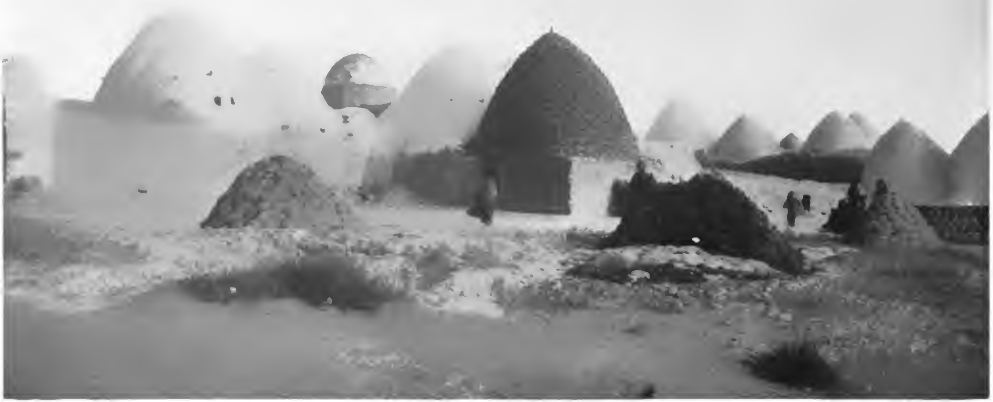
*Ali, the caliph and successor of Mohammed.



ONE OF THE PECULIAR BEEHIVE HOUSE VILLAGES NEAR ALEPPO

One is seen without its outer coating of clay. The smaller conical piles are of dried manure, used for fuel that these sounds came from the water-wheels.

A large crowd of men and boys followed us around during our inspection of the water-wheels and the town, but were very courteous and went out of their way to show us little kindnesses. Small boys bathing in the river would, for fun, get in between the spokes of the wheels and allow themselves to be carried around many times, or they would hang on the outside of the wheel and drop back into the water when half way up, which made the faces of the old men who were looking on beam, undoubtedly reminding them of like achievements in their boyhood days. Our cameras were a source of much curiosity, and a peep at the ground glass was considered a treat.

AN EVELESS EDEN

A couple of long streets arched over with masonry were the chief bazaars and were in their aspect Oriental in the extreme. Here Bedouin men armed with sword and pistols jostled townsmen in a variety of native dress. Not a European suit was to be seen except our own.

A few swarthy daughters of the desert, with their tatooed faces and flowing garments of indigo, were the only females we saw. In fact during our entire stay at Hama we did not see a towns-woman, Christian or Moslem, veiled or unveiled, upon the streets. We understood that the Moslem men are very particular about their harems, and the Christians likewise as to their ladies.

The men are very fond of outdoor life, and spend their summer evenings on the banks of the river sipping coffee and listening to the curious music of the *nauras*.

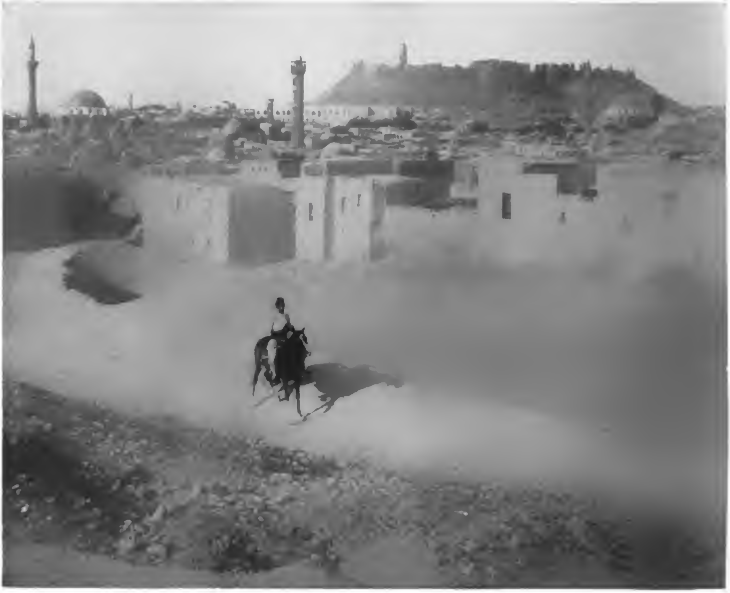
At Hama one can witness a most crude method of printing cotton goods. The operator sits cross-legged on the ground before a low table, on which is laid the hand-woven cloth. He dips short blocks of wood, with patterns carved upon them, into a dye mixed with gum arabic and presses them upon the goods. It required six to eight impressions to cover the width of the cloth and a great number of them to complete the length of a small bolt, and this tedious operation had to be repeated with every color used. The finished article resembles a very coarse Persian shawl and is sold to the peasants to cover mattresses with.

A VISIT TO THE MARKET GARDENS

As we were going out from our friend's house to visit the ***souks,*** or markets, our aged hostess, a Christian woman, followed us out into a garden, through which our path lay, and accosted two wrinkled, gray-haired men, one of whom was handling the plow and the other dropping seeds into the furrow. "May Allah give you strength!" sounded the voice of the old lady. "And may Allah strengthen you," replied the two men. "May your crop be blessed," returned our hostess. "By your presence," both murmured. After exchanging more elaborate salutations, which are common among the Arabs, she learned that they were planting corn for roasting ears, but on only half the tract. "We are keeping half to plant with bits of soot," said one, with a roguish twinkle in his eye. "Soot! What do you mean?" "To raise negroes" (slaves), came the reply.

We had now advanced too far to hear the end of the conversation, but on our return we found the old men resting under the trees, sitting on their heels. Their long-legged cows were unyoked and chewing their cud, while the wife of one of the men was cutting up water-melon to feed to a couple of half-starved sheep. We asked how their negro crop was coming on, and did not have to wait for the answer. "Khawaga (gentlemen), we are poor and own nothing. The land all belongs to the Effendis, and they exact the rent from us whether we get a crop or not. Now it is Ramadan, and during the fast they use much water in their homes, so very little of the water the wheels turn up, which we need for our vegetables, gets to us. But we dare not complain. Life is getting so hard here. We realize but one *mettalic* (1¼ cents) for a *rottle* (six pounds) of egg-plant, and tomatoes are only half that price. So I thought if I could only plant some negro slaves they might bring me better returns."

We parted, all laughing, and we walked away reflecting that even here, pinched



VIEW OF ALEPPO, SHOWING THE CITADEL DOMINATING THE TOWN

Note the round minarets with balconies, in contrast with the square minarets of Homs. A minaret of the type most common in the Moslem world is shown near the great dome to the left of the picture.

by poverty, the heart was still young that throbbed in that dried-up old case.

The low price of many commodities was noticeable. In the market we observed a sweet-meat vendor, on one side of whose tray was a little pile of the money his produce had brought in, but of it all there was no coin representing more than a fraction of a cent.

THE BEAUTY OF THE LARGER HOUSES

Most of the townspeople are rich, and it is said that about two-thirds of the farming land of the surrounding villages is owned by a few of the influential families. The houses of the wealthy much resemble those of Damascus, with a large open court in the center, where a fountain of water plays.

We visited several, one belonging to the heirs of Muaiyad Bey being especially interesting. One guest-chamber contained a small fountain; the windows were of colored glass, and the walls were covered with woodwork, ornamented with carving and stucco work in elegant floral designs, relieved with pictures and inscriptions with dates, one of which made the work about 200 years old. The general color was a commingling of deep reds, blues, green and brown on a background of gold and silver, which were reflected through the semi-transparent colors. One of the panels held a picture of the citadel hill, crowned with a fort, mosques, and houses, surrounded by a wall, the approach to which across the moat resembled the one still to be seen at Aleppo.

Leaving Hama and the Orontes, with its gardens and water-wheels, which extended some way up along the course of the railroad, we found ourselves rolling over a lifeless plain, except for here and there a flock of sheep with Bedouin shepherds. With each flock was a small donkey as a mount for the shepherd, and which followed the sheep almost like one of them, as they ran away in terror of the train.

THE "BEEHIVE" HOUSES

We now came into a region where we found a peculiar style of village, composed of "beehive houses," so called on account of their similarity in shape to the abodes of bees (see page 110).

The country is destitute of trees from which to hew rafters, and in parts there is no stone at all, and therefore the natives resort to building these curious structures of sun-dried bricks with high and steep domes, so as to resist the heavy rain and snow storms which prevail here. Each home consists of several of these huts standing near together and surrounded by a wall of similar materials. One or more is used to live in, another is for the animals, and still another serves as a granary, and so on according to the possessions of the proprietor.

We pulled up at Aleppo, one of the greatest cities of the East, a once somnolent mart, whose past prosperity and importance as a center of commerce is fast returning to it with the advent of the railway, now in the course of rapid construction, which is to connect Constantinople with Bagdad.

HONORS TO AMUNDSEN AND PEARY

THE annual banquet of the National Geographic Society, held on January 11, 1913, at the New Willard Hotel, Washington, was marked by several features of more than usual interest.

The 700 members and guests had the satisfaction of hearing the announcement that the total membership of the Society had grown to the very gratifying total of 170,000, the Society thus ranking, in point of numbers, not only as the first geographical society in the world, but also as the largest educational association in existence.

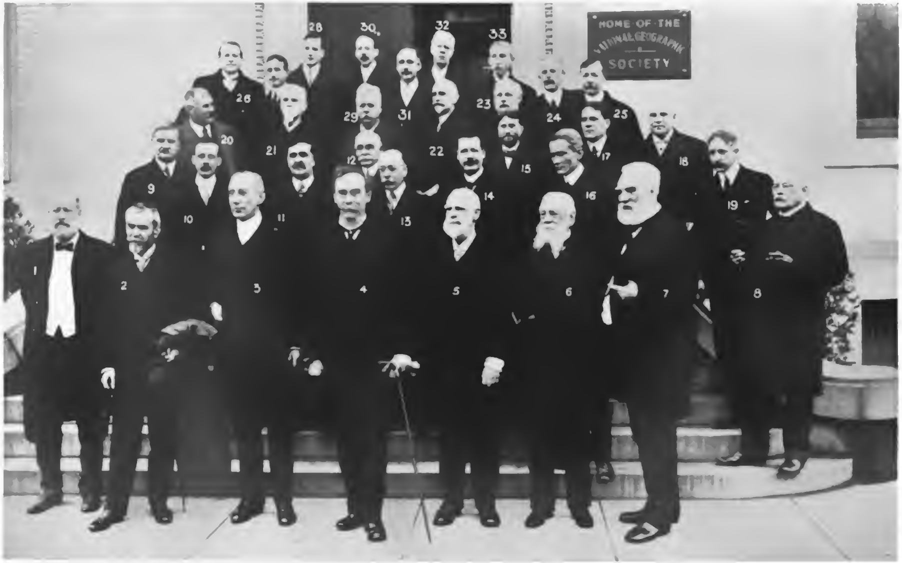
But no statistics, however satisfactory, could have accounted for so large and so distinguished a gathering. It was, as Ambassador Bryce remarked, "an occasion which had never happened before and could never happen again," a unique event in geographic history, for those present saw the discoverer of the South Pole meet the discoverer of the North Pole, from whose hands he received the special gold medal voted by the Society as the tribute of the American people to his great achievement.

With Capt. Roald Amundsen as its guest of honor and Admiral Peary as its toastmaster, the Society had before it two men who had literally come from the uttermost ends of the earth to enjoy its hospitality.

As would be expected on such an occasion, there were representatives from almost all the embassies accredited to the United States and from nearly every State in the Union.

The one note of regret was sounded when Ambassador Bryce, an old and tried friend, made his speech of farewell to the members of the Society. It was a speech worthy of his fame—graceful, witty, learned, and kindly reflecting the personality of the great English statesman and scholar who will soon leave these shores to pass the evening of his life in his native land. When he goes no good wishes will follow him more cordial and sincere than those of the National Geographic Society.

The encouragement of agriculture was represented by the novelty of the menu, which this year consisted of a fruit new to America—the Chinese jujube. These



THE FIRST MEETING OF THE POLES

The first meeting of Robert E. Peary, discoverer of the North Pole (4), and Roald Amundsen, discoverer of the South Pole (3), at the home of the National Geographic Society, January 11, 1913. The other members in the group include J. J. Jusserand, the French Ambassador (2), James Bryce, the Ambassador from Great Britain (5), the Attorney-General, George W. Wickersham (13), the Minister from Norway (14), Hiram Bingham, leader of the Yale-National Geographic Society Expedition to Peru (16). Officers and Board of Managers of the National Geographic Society: President Henry Gannett (1), Colonel Henry F. Blount (6), Dr. Alexander Graham Bell (7), Mr. John Joy Edson, Treasurer (8), Rear-Admiral John E. Pillsbury (9), Gilbert H. Grosvenor, Director and Editor National Geographic Society (10), George Otis Smith, Director U. S. Geological Survey (11), Rear-Admiral C. M. Chester (12), O. H. Tittmann, Vice-President, and Supt. U. S. Coast and Geodetic Survey (22), L. A. Bauer, Director Dept. of Terrestrial Magnetism Carnegie Institution (15), Franklin K. Lane, Chairman Interstate Commerce Commission (18), Rudolph Kauffmann, Managing Editor Washington "Evening Star" (20), Brigadier-General John M. Wilson, former Chief of Engineers, U. S. A. (21), C. Hart Merriam (29), Charles J. Bell, President American Security & Trust Co. (23), David Fairchild, Agricultural Explorer (24), George Shiras 3d, former member of Congress and wild game photographer (25), John Oliver La Gorce, Assistant Editor NATIONAL GEOGRAPHIC MAGAZINE (26), George R. Putnam, U. S. Commissioner of Lighthouses (27), Frederick B. Eichelberger, Assistant Treasurer National Geographic Society (28), Frederick V. Coville, President Washington Academy of Sciences (31), [illegible] of New York jujubes were grown, dried, and candied in California, where they had been introduced by the Department of Agriculture, and were the first of the home-grown variety to be served at a public function.

ADDRESS BY PRESIDENT GANNETT

Members of the National Geographic Society, ladies and gentlemen: It is with great pleasure that I welcome you here this evening, on the occasion of our 25th anniversary. A quarter of a century ago a few score of men assembled in the Cosmos Club and organized this Society and elected Gardiner Greene Hubbard its first President. The Society has had a wonderful growth in its membership, and today its members number 170,000. The business of the Society has likewise grown, and the total income last year from all sources was $370,000. Of this amount, after paying the running expenses and spending some $14,000 in geographic research, the sum of $50,000, more or less, was added to our reserve fund, which now stands at a total of about $175,000.

We have carried on geographic research this year in Peru and on the east coast of Hudson Bay and have made an examination of Katmai volcano, in southern Alaska, which broke out seriously last summer.

The theme this evening is the South Pole. We are fortunate to have with us Capt. Roald Amundsen, the hero of the South Pole, to whom is to be awarded a gold medal by the Society. The Toastmaster this evening is Robert Edwin Peary, the hero of the other end of the earth. I have the honor to present Admiral Peary.

THE TOASTMASTER, ROBERT E. PEARY

Mr. President and fellow-members of the National Geographic Society: I fancy it is superfluous for me to say to you how deeply I appreciate the honor of being elected by the Society as Toastmaster for this distinguished occasion. I will say to you that I recognize fully that the first qualification for the position of Toastmaster is to let the others do the talking.

Before beginning with the program of the evening I am going to read two announcements to you, the first in regard to the special delicacy which you will have the opportunity this evening to test. I might say that our members and guests always appreciate and welcome the opportunity given us by our friends, the Secretary of Agriculture and his assistants, to test some of the discoveries made in foreign lands by the agricultural explorers of the Department.

Two years ago the members of the Society were the first at a large function to test the American-grown dasheen, imported from China. Last year American-grown dates, imported from Africa and grown in California, were served to us. This year we are given the opportunity of tasting some preserved Chinese jujubes. The story of their discovery in China and of their cultivation in America is told on the printed matter which is placed at every plate this evening.

AWARD OF GRANT SQUIRES PRIZE

The first award of the Society from the Grant Squires fund, relating to commerce and industries of the Orient, has been made to the author of "Farmers of Forty Centuries," Mr. F. H. King. This book is an exhaustive study of the methods by which a very populous nation have been so skillfully cultivating their lands for more than 4,000 years that the fields of China are today more fertile than when first cultivated by man. That is a wonderful record. Mr. King's book represents what the Society believes is an ideal study of foreign places.

This Society, among other efforts in the wide field of research which it has undertaken, has been assisting in exploration in South America, and the first speaker of the evening will be the leader of the Yale-National Geographic Society Peruvian Expedition during the year 1912. This expedition, under the leadership of Dr. Bingham, has performed a most interesting work, and procured, after trials and tribulations, most valuable material.

I have the pleasure of introducing Dr. Hiram Bingham, who will tell us of the home of the Incas and their predecessors.

THE YALE-NATIONAL GEOGRAPHIC SOCIETY PERUVIAN EXPEDITION BY HIRAM BINGHAM

Mr. Toastmaster, ladies and gentlemen: I must confess that I feel rather chilly, having recently come from the tropics and finding myself so close to both poles. In fact I am reminded of an experience a friend of mine had in the Northwest, where so many of our most healthy American citizens are from the land of Captain Amundsen. This friend had the bad taste to try to take an automobile trip, bumping over some of the unmacadamized roads of the district and losing some of his tools. He finally ran into trouble and looked for a farmer to help him out of it. He asked the farmer if he could borrow a monkey-wrench. The farmer looked very sad and said, "I don't think so, my friend. My father he got cattle ranch, and my brother John, he got sheep ranch, but I think it too damn cold here for monkey ranch."

Nevertheless, it is a great pleasure to talk with members of the National Geographic Society about Peru, for one does not have to explain, as my good friend the Minister from Peru has to do sometimes, where Peru is. I went down on the steamer with a healthy young American from Chicago, who was spending some of his father's money in securing an acquaintanceship with South America, and he asked me confidentially a day or two before we got to Lima, if I would please tell him whether Lima was in Peru or Peru was in Lima.

THE EXPEDITION TO PERU

When we got to Lima we received that very cordial reception from the Peruvian government which I have always received on going to Peru. We were given every facility, and it is a pleasure to take this occasion to thank the government of Peru, through the Minister, for the many courtesies we received. In fact those who know the character of some of the mountain Indians will realize that it would have been quite impossible for us to have done our work had it not been for the kind assistance the Peruvian government extended to us on account of our connection with the National Geographic Society and Yale University.

I do not hold it against the Minister that when I got to the wharf in Callao some one (I think it was a reporter from a Lima paper) said to one of the officials to whom I had been introduced, and who was courteously passing all our baggage without any examination or difficulty: "Who are these people?" The customs official said: "Oh, some of them are scientific men." "And who are the rest?" "Well, the rest are professors."

In 1911 we began a topographical cross-section of the Andes, which, owing to the tremendous difficulties of the undertaking and the magnitude of our program, we were unable to complete.

Owing to your generosity, we were able this year to take an expert topographical engineer and a corps of assistants, who did excellent work, and whose work I hope you will all live to be proud of.

We also made a special study of the osteology and geology of the Cuzco region, and came to the conclusion that the human remains found there last year were not nearly so old as had been at first supposed.

One of our principal geographical tasks lay in the identification of several cities and towns described in 1911. In particular, there was that remarkable "White City," a remarkable buried city, away down in the jungles on the Urubamba River, below Ollantaytambo, which place was supposed by Squier and other students of Peruvian archæology to be one of the frontier fortresses of the Incas. Down below this place, and buried in jungle, we found a city called Machu Picchu.

THE FIRST CAPITAL OF THE INCAS

That is an awful name, but it is well worth remembering. The city, built of white granite, is on top of a ridge surrounded by precipices from two to three thousand feet high, above the Urubamba River, at a distance of four or five days journey from Cuzco, the well-known Inca capital. Last year we were not able to do more than make a reconnaissance of this old city, but we realized that it was very important and were anxious to study it more, and to try to find out something about its builders. We could find nothing in the chronicles anywhere. No one, with the exception of a few Indians, had ever heard of it. The name was not known in Cuzco, only a few days' journey away. Nobody in Lima had heard of it.

Fortunately, owing to your interest, and largely through your generosity, we were able to go back this year and spend four months and a half at Machu Picchu. We spent about $2,000 simply in clearing the tropical jungle from these ruins and excavating them, taking off the dirt and decayed foliage that had accumulated for many centuries.

We found the city had 150 houses, built of white granite; palaces, temples, and more especially stairways. We uncovered over 100 stairways of white granite, containing a total of more than 2,000 steps. This does not include several stairways leading off into the jungles and up the side of the mountains, one of which was nearly half a mile in length.

We found also that Machu Picchu was a city essentially of windows. Standing at one point, after we had cleared the ruins, we could count in the walls of the houses about 55 windows—a very extraordinary occurrence. This fact leads me to believe that Machu Picchu was the place from which the Incas came when they started for Cuzco and established the Inca Empire.

When we went down there last year we were looking for Vitcos, the *last* capital of the Incas. By accident, in running down those ruins, we stumbled on the *first* Inca capital. As it was owing to your generosity that we were able to make these and several other important discoveries, I take great pleasure in thanking you on behalf of Yale University. We hope eventually to be able to prove by our excavations and the material we have brought away the connection of Machu Picchu with the later Inca Empire.*

THE TOASTMASTER, ROBERT E. PEARY

I may say, supplementary to Dr. Bingham's brief, modest, and interesting remarks in regard to his work, that his discoveries of these ancient cities have astounded the scientists of the world.

We have with us tonight the beloved familiar face of our old, tried, and true friend, an indefatigable globe-trotter, who has been everywhere on earth except, perhaps, at the poles. He is the representative of our cousins across the sea, one of whom, Shackleton, pioneered the way to the South Pole, and another of whom, Scott, is still down there, or, as we hope, may be now on his way home with a splendid record of exploration and scientific work.

I do not know what Ambassador Bryce is going to talk about any more than you, nor do I need to know; but whatever he says will be worth saying and it will be well said.

His Excellency the Right Honorable James Bryce, Ambassador from Great Britain.

ADDRESS BY THE BRITISH AMBASSADOR, MR. BRYCE

Mr. President, Mr. Toastmaster, ladies and gentlemen: I am very much honored by being asked to say a few words to you this evening, and I feel that it is a real privilege to be present on an occasion so historic that it makes us all feel as if we were historic figures ourselves. This is an occasion—a conjunction of discoverers—that has never happened before and can never happen again.

My friend, Professor Bingham, says that he felt cold in the neighborhood of the poles. I have the honor of being between the two poles and therefore in a warm climate. I suppose I cannot call myself the Equator, for that honor belongs to your President, who is exactly in the middle. May I claim, being nearer the South Pole, to represent the tropic of Capricorn?

It is a great occasion, ladies and gentlemen, when we meet both of the discoverers of these two remotest and least accessible parts of our earth. They have accomplished that which all nations have dreamed of for centuries as doubtfully possible at all, and that has been accomplished by the enterprise, courage, science, perseverance, and faith of two such remarkable men. Their names will go down to the remotest posterity, and it is a privilege to all of us to have met them on the first occasion when they are together. As we heard from Admiral Peary two years ago, so we heard from Captain Amundsen, a narrative of his achievements—plain, simple, straightforward, modest, impressive.

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*An early number of the NATIONAL GEOGRAPHIC MAGAZINE will contain a complete account, with 150 illustrations, of Dr. Bingham's remarkable discoveries.

I cannot fancy listening to what he told us today without being struck by the fact that the man who approached his great task in so simple a spirit and with such a forecasting mind showed his qualities in the way in which he told it as well as in the way he accomplished it.

A TRIBUTE TO PROFESSOR BINGHAM'S WORK

You will hear, from those who are to succeed me, more about the South Pole and about what Captain Amundsen has done. Let me therefore say one word about what our friend, Professor Bingham, has done. His modesty has prevented him from giving you anything like a full account of the additions he has made to geographic knowledge. He has cleared up some very long-standing and difficult problems in primitive Peruvian history; he has explained many features of the neighborhood of Cuzco which had puzzled previous inquirers; he accomplished in his previous journey a remarkable ascent of one of the loftiest peaks in the Andes, and he has now secured a mass of archæological material which I think will occupy him and your archæologists in this country years in collating, describing, and interpreting.

I think, ladies and gentlemen of the National Geographic Society, that you may now feel well pleased with the generous liberality which your council exercised a year ago when it made a grant for the undertaking of this expedition by Mr. Bingham. The expenditure has been amply justified and amply rewarded by that which he has discovered and brought home.

WHAT GEOGRAPHIC DISCOVERIES REMAIN FOR THE EXPLORER?

I remember, on one of the previous occasions when I had the honor of addressing you, observing that those of us who care for geographical science seemed to lie under the danger of having, sooner or later, our theme exhausted. We have not yet found a means for the exploring of any other part of this universe except our own planet. With our planet so limited in its area, and now rendered so comparatively accessible in every part, with its population growing so fast, and the number of its explorers increasing, it is natural to believe that before very long there will be no great discoveries left to make. Certainly no discoveries remain to be made so striking as these which have been made of the two poles.

We may, however, comfort ourselves by reflecting that there is another kind of work to be done, and the work which Professor Bingham has done seems to me to show how large that work is and how full of interest and instruction it may be made. Professor Bingham has taken a region which has been known, more or less, since the time of the Spanish Conquest, in the middle of the 16th century; but he has revealed immense fields of further inquiry, which had not been little thought of until he went there.

Has not the time come when we may apply to geography what may be called, in the language of agriculture, "intensive cultivation," when we may begin to bestow upon the surface of our planet a study so full, so exact, so carefully scientific, that we shall examine every part of it from the point of view of the various sciences and from the point of view of the events that have happened since man found him strong enough to deal with and overcome nature. Orography, geology, botany, meteorology, zoology—all these sciences are the handmaids of geography.

THE OBSOLETE TERM, "MAN"

In the largest sense of the word, they may all be called branches of geographic science, which is nothing less than the whole knowledge of our globe, and which is to be worked out by study applied in these various departments. That is to be supplemented also by a study of history of what man has done in these parts of the world where nature permitted him to settle and thrive. So you may say geography is the meeting point of all these sciences, a great stream into which they all pour their tributary brooks. Geography tells us what Nature has offered to Man and what Man has made of Nature.

Possibly I should apologize for using the perhaps obsolete term "man," considering that some of your Western States, following in the wake of Australia and New Zealand, have recently transferred the political, as well as the social scepter from man to woman, and especially considering the fact that this victory is going to be celebrated in Washington upon the third of March by a procession. I will therefore withdraw the obnoxious term and say "human nature."

MR. BRYCE'S FAREWELL

Ladies and gentlemen, I reflect, with sadness, that this is probably the last occasion on which I shall have the pleasure of meeting you here—at any rate, as the representative of my country. I wish to take this opportunity, in saying farewell, of thanking the National Geographic Society for its constant invitations to my wife and myself, and not only for the hospitality we have received from you, which we have warmly appreciated, but also for that welcome which doubles the value of your hospitality.

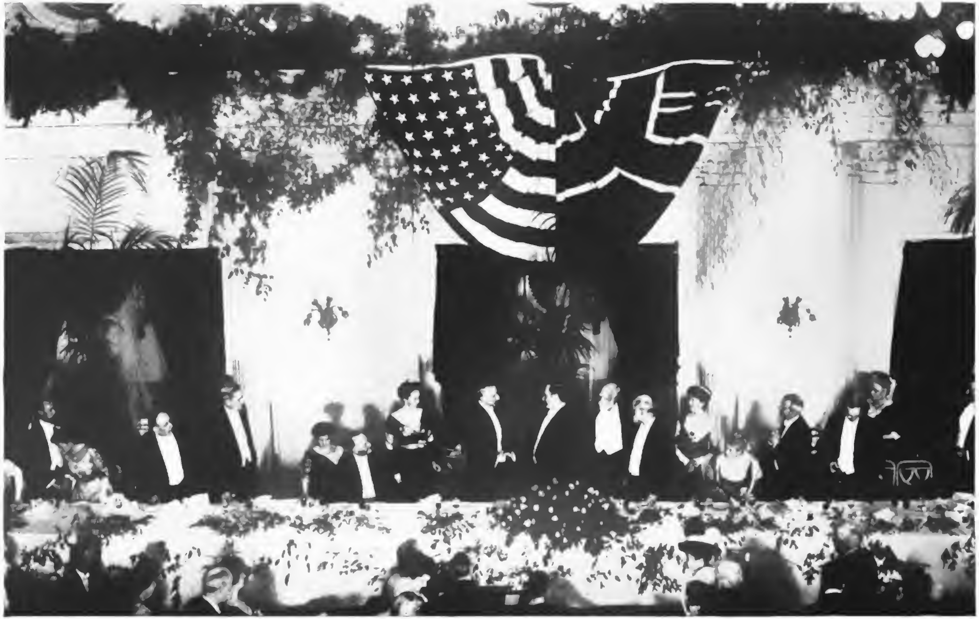
Among all the pleasant gatherings which we have been privileged to attend in Washington, among all the friends whose constant kindness we gratefully acknowledge, here and elsewhere through your country, there are no gatherings which we shall look back upon with more pleasure and with a more grateful memory than those of the National Geographic Society. Here we have rejoiced to meet many who were interested in the same subject, who were alive to all the movements of the world and were eager to help them forward. Here we have always noted and been impressed by the feeling which has pervaded your gatherings, that all nations and all men of science and learning ought to be united by ties of sympathy and mutual helpfulness in endeavoring to advance science and learning and to promote also the peace and good understanding between nations which ought always to go therewith. To be present at such gatherings as this has been to us a constant pleasure. We shall always remember them, and we venture to hope, ladies and gentlemen, that sometimes you will remember those friends who have left you to recross the Atlantic and who will never forget you.

May I express my wish for the continued growth, prosperity, and usefulness of this Society, which in so short a time has attained a position of such prominence among the geographic societies of the world, in its numbers as well as in its activity. It is the hope of all your English fellow-workers that for centuries to come the members of your Society may still find something fresh to do, and that their zeal and earnestness may know no weariness or abatement.

THE TOASTMASTER, ROBERT E. PEARY

I voice the thought of every one in this room when I say I sincerely hope that Ambassador Bryce's prophecy may not come true, but on the contrary we shall many more times have the pleasure of welcoming him and Mrs. Bryce here at the meetings of the National Geographic Society. Comments upon Ambassador Bryce's remarks are impossible and superfluous. Diplomat, student of people and countries, whenever he speaks the fullest measure of pleasure and instruction goes to his hearers.

Our next speaker is a successful man of business affairs, one of our prominent legislators, a man who has felt and seen and believes in the extension of geographic instruction. Whatever he may have to say upon this subject of the need of geographic knowledge will be well worth our consideration. I have the pleasure of introducing to you Hon. William C. Redfield, of New York.



ADMIRAL PEARY, DISCOVERER OF THE NORTH POLE, PRESENTING TO ROALD AMUNDSEN, DISCOVERER OF THE SOUTH POLE, THE SPECIAL GOLD MEDAL OF THE NATIONAL GEOGRAPHIC SOCIETY, JANUARY 11, 1913

The others in the group at the table, beginning on the extreme left, are: The Chinese Minister, Mr. Chang Yin Tang; Madame Chang; the Bolivian Minister, Señor Don Ignacio Calderon; Hiram Bingham; Mrs. Robert E. Peary; Representative William C. Redfield; Mrs. Walter L. Fisher; Roald Amundsen; Robert E. Peary; the British Ambassador, James Bryce; Henry Gannett, President National Geographic Society; Madame Jusserand; Mrs. Bryce; the French Ambassador, J. J. Jusserand; the Secretary of the Interior, Walter L. Fisher; Mrs. William C. Redfield; the Minister from Norway, Mr. H. H. Bryn

MR. REDFIELD, ON THE NEED OF GEOGRAPHICAL TEACHING

Mr. President, Mr. Toastmaster, ladies and gentlemen: If we may follow the geographical parallel, the position in which I find myself this evening is that of the English Channel, which separates Great Britain from France. It has a somewhat unsavory reputation, but I venture to hope it may not add tonight to the evils which it has visited heretofore upon suffering humanity.

I am but a voice this evening to mention a need and to offer a suggestion, neither more nor less. It is somewhat embarrassing, when one has tried faithfully to teach a working force of supposedly intelligent young Americans something as to where some places are on this globe, to be told by one of them, in answer to a question, "Where is Jamaica?" that it is an American island in the Pacific Ocean. It is almost as bad to be told in Manila that a large Boston firm wrote to a house there on the 8th of June demanding payment of an account, and wrote again on the 25th of June wondering why they had not received a response. It is also equally bad to be told that a large New York concern referred an actual inquiry from Panama to its agent in the Philippine Islands.

I have, unfortunately, been obliged to make an effort to employ young American men and women who were supposed to have some elementary knowledge of geography. I have never found it possible to get one with those qualifications. I think that statement, if you mean by "elementary" the fact that there are continents, is not correct, but if it means any sort of useful knowledge that was available at call as to where the important countries and cities of the world were, I believe it is correct. That is to say, if you attempt to employ young people of from 16 to 25 years of age at any pay running from $10 to $20 a week, you will not find it practicable to obtain from any of them a ready, ordinary common knowledge of the chief cities of the globe. I think that statement is well within the fact.

I doubt very much if a graduating class in our universities could answer correctly 20 out of 25 rather ordinary geographical questions. For example, let us take a practical illustration out of every-day office life.

THE LACK OF GEOGRAPHIC KNOWLEDGE IN COMMERCE

A shipment of machinery is to go to the town of Bandoeng, in the center of Java, and we will call our clerk or tell our stenographer to find out whether this shipment should go by way of Rotterdam and by Dutch steamer to Batavia and thence by rail, or whether it should go to London and thence by P. and O. steamer to Colombo and then via Singapore to Batavia and thence by rail, or whether it should go west by way of San Francisco and Manila and Hongkong, on a chance of catching the steamer for Soerabaja or Semarang and by rail from either point.

I imagine, Mr. Toastmaster, that some of them are caught now, and yet, ladies and gentlemen, with the exception of Bandoeng, there is not one place mentioned that is not a large seaport of prime commercial importance. Not one of those cities but has daily in its harbor many large commercial vessels. There is not one of the towns mentioned with which this country is not in daily, if not hourly, communication by mail and wire, and the statements I have made are taken from facts out of the ordinary commonplace work of a business office.

Our clerks do not know, and there is no place in America today where our young people can get the thorough teaching that will give them a working knowledge of where these places are.

Every day young women as stenographers and young men as clerks are called upon for this knowledge, and their employers are keeping kindergartens to instruct them because the schools do not. It is not the fault of our young people, but their misfortune.

That is a very plain statement of a commonplace fact that every business man who is engaged in foreign commerce knows all about. It is a very serious handicap.

HOW TO REMEDY IT

The suggestion is this: Cannot this Society, in some way, learn the facts as to the ignorance of the average American young man and woman on the subject of geography? Secondly, having learned them, cannot this Society, in some way, standardize, or attempt to standardize, geographical teaching?

I can say for one very large organization of business houses that if young men or women were to apply to any of the 150 concerns therein represented, bearing some sort of a certificate that the school in which they had learned geography conformed to the standards set by the National Geographic Society, employment would be quicker for these people and wages would be higher. I make the suggestion that something of this kind may possibly, in time, be started, because another scientific society, finding a similar state of ignorance in another line, is now attempting to formulate some standard of instruction that will be country-wide. At the present time, however, our school-taught young men and women of 18 and 20 years of age do not know practically enough geography to trust themselves out at night alone.

THE TOASTMASTER, ROBERT E. PEARY

There is certainly much need for thought in Representative Redfield's remarks. If I might venture, I would suggest that if Mr. Redfield and others would be willing to utilize their commanding positions to assist this Society in the construction, either here or in New York, of a great globe on a scale of 1 to 1 million—which is a scale advocated by representative national geographic congresses for a universal wayof the world—that such globe would enable the business men, the traveler, the student, and the school children to keep in touch with the big as well as the small details of geographical information, which information could be transferred to this globe from time to time as secured over the world, thereby making the globe continuously up to date. An hour or two of visual work on such a globe as that would count for more than days of reading of geographical books.

Across the water there is a sunny land—the birthplace of the automobile, the leader of the world in aviation today, a country in the front rank of every sphere of human activity. The sons of that country have written French names within the Arctic and the Antarctic.

The last of these, Jean Baptiste Etienne Auguste Charcot, the National Geographic Society has elected an honorary member in recognition of his splendid researches and explorations in the south polar regions. The certificate of his election will be received for him by another illustrious Frenchman, also our friend and long acquaintance, His Excellency Monsieur J. J. Jusserand, the French Ambassador.

ADDRESS BY THE FRENCH AMBASSADOR, MR. JUSSERAND

Though prevented from being present at the comestible part in tonight's ceremony, I greatly desired not to miss it altogether, not only because I was sure Admiral Peary would speak with his wonted forceful eloquence, but because I have made it a rule ever to be present when Captain Amundsen is honored for having discovered a pole.

Five years ago we celebrated together the deeds of this Viking's son and of his good ship, *Gjoa,* with which he had, shortly before, ascertained the exact position of the north magnetic pole, and seconded by a crew of six men had, first of all sailors in the world, navigated that northwest passage vainly attempted by innumerable predecessors, from the 16th century to our time.

Like the present occasion, that one was brilliant and memorable, and I am not the only person in this assembly who was there and still cherishes its remembrance. The members of the National Geographic Society were present in imposing numbers; at different tables several explorers of fame were seated; pointing to one of them, a neighbor of mine at table said: "You see that gentleman with the long mustache? Many are making the attempt, but if the North Pole is to be reached by any one, it is he who will do it; he is called Peary." All the world now knows whether my neighbor was or not a good prophet.

A BRANCH OF THE JUJUBE TREE, LOADED WITH FRUIT, GROWING IN CALIFORNIA

American-grown jujubes were first served in the United States at a great public function on the occasion of the Annual Banquet of the National Geographic Society, January 11. These jujubes represented one of the tangible results of agricultural exploration as it is carried on by the Department of Agriculture.

The jujube is one of the five principal fruits of China, and has been cultivated for at least 4,000 years. A Chinese work published 800 years ago listed 43 named varieties; hundreds are described in the more modern works. In China this fruit is highly esteemed, and there are hundreds of varieties, differing in shape, size and flavor. There is even a seedless one and one as large as a hen's egg. Some are eaten fresh and others are candied and dried or used for preserves. The seedless sort is stewed with rice, much as we use raisins.

The jujubes served at the National Geographic Society banquet were grown at the Plant Introduction Garden at Chico, California, and had been candied in syrup and dried. Many of the varieties thus preserved have almost exactly the shape, color, and flavor of dates.

Here, then, is a new fruit as delicious as a choice date and capable of being grown hundreds of miles further north than the date palm. Trees growing in Washington, D. C., were entirely uninjured by temperatures as low as 17 degrees below zero last winter.

THE ACTIVITIES OF MR. BRYCE

And while others were exerting themselves in far-off lands, most of us Washingtonians were staying at home, anxious for news, but very quiet in this beautiful city. Some exceptions there were, however, one being my British colleague, who was present at the other dinner and is also with us tonight; he did not remain dormant; it is not his fashion. Sure it is that he has in the interval increased the number of his travels, of his books, of his speeches, but not, to all appearances, the number of his years.

Between the dates of the two dinners memorable deeds have been accomplished, causing the unique event which we are going to witness to be possible. Those hands will clasp before us that have planted the flag of their country at the extremities of the world.

We went yesterday to the Masonic Temple, holding tickets in our hands. The carefully devised inscription on them read: "Admit to the South Pole," and we were indeed admitted there. With his clear, plain, straightforward manner of expressing himself, Captain Amundsen truly led us to the pole. We took part in his undertaking, his dog-breeding establishment, his clever preparation, and his long, long journey across unknown solitudes, till at last the goal was reached, Queen Maud's Land was baptized, and Norway's flag planted where no man had set his foot before. The orator spoke calmly; we can scarcely do the same when talking of what he has achieved.

In its kindness the National Geographic Society has desired to associate a French name to the famous ones we are honoring tonight, the name of Dr. Jean Charcot.

THE EARLY FRENCH EXPLORERS IN AMERICA

In the dash to the pole, France, it is true, took no decisive part. There is, however, some dash, I dare say, in my nation, but the kind of discoveries which have ever been the special aim of her sons are the inland ones. While others were exploring coasts we, from the first, have taken a particular pride in assuming the often hard task of exploring the interior of countries. This was conspicuously done on this continent when those singularly bold expeditions of our early explorers took place which are just now the subject of admirable articles by President Finley. The valley of the Mississippi was as a whole first explored by French people, and the names of Chicago, St. Louis, New Orleans first appeared on French maps. The same in Asia with Bonvalot, Dutreuil de Rhins, Pavie, Lefèvre-Pontalis, and all the others; the same in Africa with Foureau, Lamy, Brazza, and their peers.

We did not, however, entirely neglect the polar regions; witness those sailors whose names have just been recalled by that good judge in such matters, Admiral Peary, witness especially the work done before Charcot by Dumont d'Urville, with his tiny frigates, the *Astrolabe* and the *Zélée*, and his visit, toward the end of 1837, to the Great Barrier. As he sailed along he sighted a rift and drove his ship through the narrow chasm, which closed behind him. For five days he was there a prisoner, with no apparent hope for his life and that of his crew, when a lucky storm caused a cleavage in the ice which, with the help of saws and axes, they were able so to increase as to bring the ships safe again to the open sea.

THE FRENCH IN THE ANTARCTIC

On a second expedition, in 1840, he explored vast antarctic regions yet unknown, some still bearing on every map the names he gave them: in particular that of his dearly admired wife, Adélie, the god-mother of *Adélie Land*. On his return, in 1841, he was presented with a medal by our Geographic Society, the same medal which the same society presented the other day to Captain Amundsen in Paris.

Dr. Jean Charcot has proved a worthy successor to Dumont d'Urville, and I offer on his behalf sincere thanks for the way in which you tonight so kindly show your appreciation of what he has done. What he wanted was at all risks to be useful, and he succeeded in perfecting our knowledge of an unknown part of the Antarctic Continent, one not particularly easy to explore. Acting with the earnest desire to help toward a complete survey of an unexplored section, he discarded all idea of duplicating the work of other explorers or of competing with those who, duly prepared for the attempt, were planning their dash to the pole. As testified by your award tonight, by the praise which our chairman has bestowed on him, and by the tokens of appreciation conferred on him by his peers in several countries, he succeeded in what he had planned; our knowledge has been considerably increased, thanks to his exertions, and the fatigues and dangers he and his companions underwent have not been wasted.

DR. CHARCOT'S ACHIEVEMENTS

Owing to his two expeditions, with the *Français* in 1904-1905 and the *Pourquoi Pas* in 1908-1910, presidential names have been added to the royal and imperial ones, recalling almost all Europe and the United States, too, at the southern end of the world. Europe will be more completely duplicated—a quiet, silent, snowbound Europe—now that there is a *Loubet Land* and a *Fallières Land*.

No poles at present remain to be discovered, and the line of coasts of the Southern Continent has been in a great measure explored. What will such men as Shackleton, Charcot, Peary, Amundsen now do? We do not know; perhaps they do not know. Of one thing we are sure—that is, that whatever they attempt will be worthy of their name; whatever it be we wish them success.

THE TOASTMASTER, ROBERT E. PEARY

It has been my good fortune on several occasions and on entirely different subjects to listen to Ambassador Jusserand, and in every case it has been a distinct and emphatic pleasure. His clear-cut diction lifts as the wings of the aëroplane and carries us direct to the point with the directness of the automobile. I wish my friend Charcot could have been here tonight to hear of his magnificent work in the Antarctic regions so ably presented.

We have with us tonight a man who has had experience in both the tropical and the Arctic regions, and I am going to ask him to give us a few remarks upon his experience in those localities. I take pleasure in presenting Mr. Walter L. Fisher, Secretary of the Interior.

SECRETARY FISHER

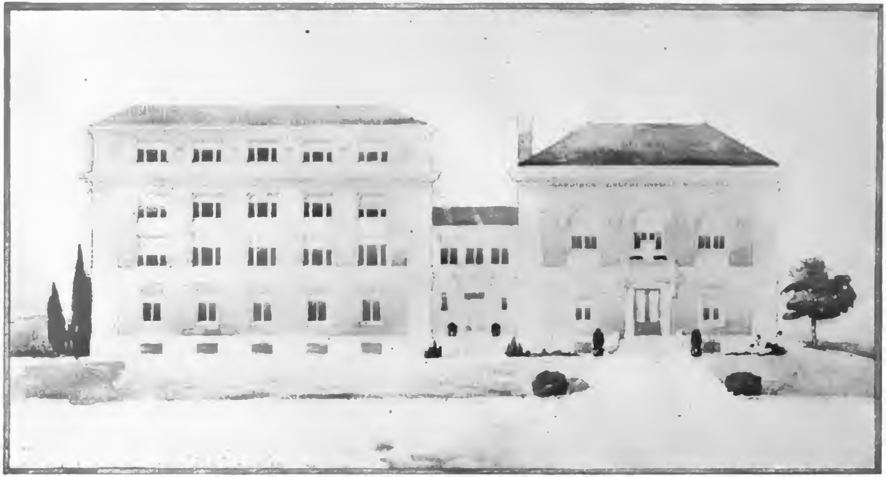
Mr. Toastmaster, ladies and gentlemen: It has been suggested to me that I should say something to you about those far outlying posts of the Department of the Interior in this country, that after all get into the realm of exploration. I have made two very slight voyages of discovery, one to Hawaii and one to Alaska, but on both occasions my object was the investigation of industrial and economic conditions and not of geography.

Of course, I realize that the Department of the Interior has much to do with the subject with which this Society is concerned. A great deal of the geographical work of the United States government is carried on under its direction, the work of the Geological Survey particularly, and in the opening remarks of the President I noted with some interest that this Society has spent some money with some energy upon the recent eruption of a volcano in Alaska.

HAWAII AND ALASKA

The two countries which have been suggested to me have a singular resemblance and singular differences. I do not know whether all of you have thought of the points of resemblance so much as you have of the points of difference; but if for a moment we consider the fact that Alaska is largely volcanic; that it contains some of the few active volcanoes of the world; that it has recently had the most active eruption, we may see one of the resemblances. The volcano which can be best observed for scientific purposes, the volcano which is most accessible and most interesting to the traveler, is that which exists upon the island of Hawaii.

The territories are very different in most respects. I do not know whether I can in this brief notice succeed in repeating to you something that has been written to describe these differences in verse, possibly not intentional in either



THE HOME OF THE NATIONAL GEOGRAPHIC SOCIETY

The building on the right, Hubbard Memorial Hall, was given to the Society for its home by the family of its first President, Gardiner Greene Hubbard. At that time (1903) the Society had 2,000 members. The building on the left is the new office building now under construction and made necessary by the ever-increasing popularity of the Magazine of the Society. The Society now has 170,000 members.

case, and yet if I am able to remember the lines they may carry home some of these distinctive features and may illustrate the different spirit which pervades those far outlying territories of ours.

The island of Hawaii, of course, lies in the tropic or semi-tropic region, and it has a poetess, in the person of the wife of the present Governor of the island, who has written a poem which perhaps describes the sentiment and the atmosphere of those islands better than any other of which I know. It runs something like this:

MY ISLANDS

On the edge of the world my islands lie,
Under the sun-steeped sky,
And their waving palms
Are bounteous alms
To the soul-spent passer-by.

On the edge of the world, dear islands, stay,
Far from clamorous day,
Content with calm,
Hold peace and balm,
Be Isles of the Blest for aye!

The port of the northern clime is of much rougher variety. I do not know how much you know about the country which got its greatest notoriety from the rush to the Klondike. That rush was celebrated in a poem, which has in it vigorous lines like this:

You've read of the trail of Ninety-eight, but
  its woe no man can tell;
It was all of a piece and a whole yard wide,
  and the name of the brand was "Hell."

But the poem which best describes that land is perhaps the "Spell of the Yukon," written by Robert W. Service.

THE SPELL OF THE YUKON

I wanted the gold and I sought it;
  I scrabbled and mucked like a slave.
Was it famine or scurvy—I fought it;
  I hurled my youth into a grave.
I wanted the gold and I got it,
Yet somehow life's not what I thought it,
And somehow the gold isn't all.

No, there's the land. (Have you seen it?)
  It's the cussedest land that I know,
From the big, dizzy mountains that screen it
  To the deep death-like valleys below.
Some say God was tired when He made it;
  Some say it's a fine land to shun.
Maybe, but there's some as would trade it
  For no land on earth—and I'm one.

There's gold, and it's haunting and haunting;
  It's luring me on as of old;
Yet it isn't the gold that I'm wanting
  So much as just finding the gold.
It's the great, big, broad land 'way up yonder;
  It's the forests where silence has lease;
It's the beauty that thrills me with wonder;
  It's the stillness that fills me with peace.

THE TOASTMASTER, ROBERT E. PEARY

In the first chapter of Genesis we read that the Creator, after having first separated the light from the darkness and the earth from the land, filled the land with vegetation and the sea and the air with life, creating man, and said: "Let them have dominion over the earth." Only now, with the attainment of the two uppermost parts of the earth—the North and the South Pole—has that scriptural command become realized.

Today there are, broadly speaking, no large regions on the face of the globe that have not been traversed or penetrated by that incomparable, wonderful, adjustable machine—the human animal—guided by the flame of divine intelligence.

Ended is that splendid series of great ventures and voyages, beginning with the first pushing out of the Phœnician navigators through the Pillars of Hercules into the frightful storms and fearful terrors of the great Atlantic; the crossing of the Equator, where the sun's furnace heat, it was thought, scorched men black; the rounding of the Cape of Good Hope; Columbus' splendid launching into the mysteries of the unknown West; the circumnavigation of the globe; the accomplishment of the Northeast and the Northwest passages; the attainment of the North Pole and the South Pole.

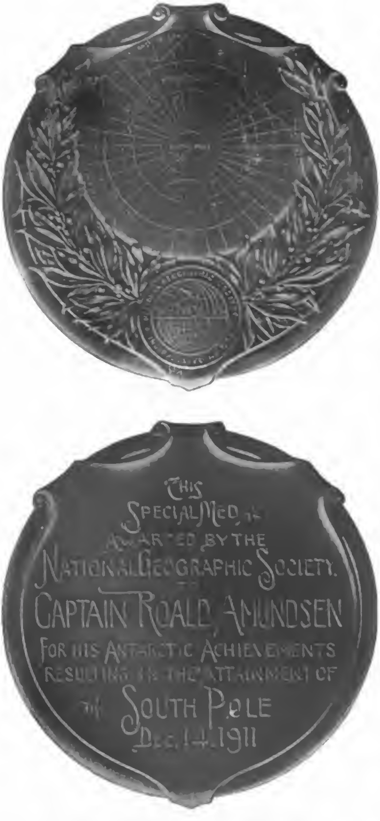
Ended is the long list of strange conceptions of the shape and character of this world of ours.

THE POLAR MYSTERIES VANISH

Vanished are those mysterious regions about the two poles, filled with strange imaginary conditions and peoples.

Gone is the "Open Polar Sea"—"Symmes Hole"—the Garden of Eden; the glistening Lodestone Mountain; the huge ice-cap; the great crater-like basin.

Though every one in this hall tonight knows that the last of the poles has been discovered, I fancy there are some of


This
Special Medal is
awarded by the
National Geographic Society
to
Captain Roald Amundsen
for his Antarctic Achievements
resulting in the attainment of
the South Pole
Dec. 14. 1911

THE SPECIAL GOLD MEDAL AWARDED TO ROALD AMUNDSEN BY THE NATIONAL GEOGRAPHIC SOCIETY

you who have not yet grasped clearly the striking contrast in almost every physical condition at those two points. As a matter of fact, the conditions at the two poles are as far apart as the poles themselves.

Yet, though every one of my auditors knows that the last of the poles has been attained, I have no doubt that some of us have not grasped clearly the striking contrast of physical conditions existing at those two points.

Conditions at the two poles are as unlike as the poles are far apart. The North Pole is situated at the center of the hemisphere of the land, yet is itself located in an ocean.

The South Pole is situated at the center of the hemisphere of water, yet is itself located in a continent.

An explorer at the North Pole stands up on the frozen surface of an ocean two miles or more in depth.

An explorer at the South Pole stands on the surface of a great interior snow cap two miles or more *above* sea level.

The most northery North Polar lands possess a comparative abundance of animal life—musk-ox, reindeer, Polar bear, wolf, fox, arctic hare, ermine, lemming, and land birds, as well as forms of insect life—and during a few short weeks in summer numbers of brilliant flowers.

On the Antarctic continent there is absolutely no form of animal or vegetable life, though two or three species of sea birds breed during a few weeks in summer at several localities on the coast.

Human life is found within some 700 miles of the North Pole.

The nearest human life is some 2,000 miles from the South Pole.

Efforts to attain the North Pole have been going on for nearly 400 years.

Efforts to reach the South Pole date back 140 years.

The history of North Polar exploration is studded with crushed and foundering ships and the deaths of hundreds of brave men.

The history of South Polar exploration shows the loss of but one ship and the loss of two or three men.

In *one* respect the two poles are alike.

Their conquest depended, in the last analysis, upon the first primal machine, the most wonderful and adjustable of all—the animal, man, and the Eskimo dog.

THE DISCOVERER OF THE SOUTH POLE

Sitting at this table is a man—look in his eyes and try to imagine to yourselves what those eyes have seen—a man who forced his way across hundreds of miles of icy Antarctic waste; climbed thousands of feet into the frozen Antarctic air, and stood at last more than two miles above sea level, with a frozen desert stretching from his feet to the horizon, and the yellow sun circling parallel with the horizon, at the South Pole—Amundsen, of Norway.

Amundsen, for your "Antarctic explorations, resulting in the attainments of the South Pole," The National Geographic Society has awarded you this special gold medal.

You already hold the Society's other grand prize—the Hubbard gold medal—for your successful forcing of the first ship through the Northwest passage, from the Atlantic to the Pacific, and for your definite re-location of the North Magnetic Pole.

In one respect this medal is unique. Within its yellow circle is crystallized the appreciation of 175,000 intelligent men and women, the members of this Society. In this respect no other trophy you have, or will receive, can equal it.

Health, strength, good luck continue with you.

CAPTAIN AMUNDSEN

Mr. President, Mr. Chairman, ladies and gentlemen: I am not going to try to make a speech here tonight after all these delightful speeches which we have heard delivered from those illustrious and distinguished men here tonight. I am only briefly going to thank the National Geographic Society for the great hospitality and the great kindness which they have shown me this time. This is not the first time. I came here five years ago and I was received when I came as a stranger, but I went away, as I felt, a good, dear friend. I went away with the highest honors from the Society. The feelings I had at that time toward the Society were highly strengthened by the hospitality and the sympathy which it extended to me here.

I certainly appreciate very highly this special gold medal, the highest medal which the Society can bestow upon an explorer. I appreciate it highly, but I also appreciate still more highly the way in which I have been handed this medal. I have been handed this medal, I might say, from the most illustrious of the living polar explorers.

From the time I was a boy I followed Admiral Peary in his work; I was with him when, in 1890, for the first time, he crossed Greenland. I was with him in my thoughts; I was too young to try to follow him, but I have followed him in my thoughts and later in his work. I followed him when inch by inch he worked his way toward the north, inch by inch, foot by foot, and yard by yard until he finally succeeded in planting the Stars and Stripes on the most difficult part of our globe.

I am mighty thankful to you, Admiral Peary, for all the experience and all the assistance you have really given me in my work.

WHY AMUNDSEN SOUGHT THE SOUTH POLE

There is one thing which perhaps not many of you here tonight know, and that is that it was really Admiral Peary who sent me out to the South Pole. I was preparing my trip toward the North Polar regions—it may be to the North Pole—in 1909. It was not very easy to start an expedition from Norway, for it was hard work among us to raise money and I was preparing this expedition slowly.

Then suddenly the news flashed all over the world that the North Pole had been attained; that Admiral Peary had planted the Stars and Stripes up there. The money, which had been scarce, now went down to nothing. I could not get a cent more and I was in the midst of my preparations.

One of the last mysterious points of the globe had been discovered.

The last one still remained undiscovered, and then it was that I took the decision to turn from the north toward the south in order to try to discover this last problem in the polar regions.

So you see it was really Admiral Peary who sent me away. Well, I thank you, Admiral, for that.

I am now going to thank the National Geographic Society for all they have shown me in the way of kindness and hospitality, and permit me, in closing, to wish the Society every prosperity in the future. The President recently told us that the Society at present holds a membership of 175,000, I think the largest by far of the geographic societies in the world. I wish the Society a continued growth, and when I come back from my North Polar Expedition I hope I may find it holding a membership of at least 300,000.

THE TOASTMASTER, ROBERT E. PEARY

I thank you heartily, Captain Amundsen, for your friendly remarks in regard to me.

You have listened to the words of a man who has accomplished a great thing. I need not go into details. You have heard from his own lips the story of how he pitted red blood, tense muscles, and the insistence of the human brain against the cold, the hunger, the fatigue of the Antarctic hell, and won.

The presence of such a man as Amundsen in our midst ought, and I hope will, spur us as individuals, as Societies, and as a nation to take our proper share and part in the great work yet to be done in the Antarctic.

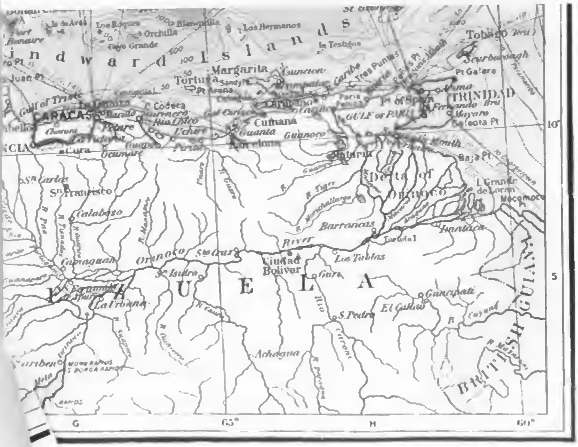
There are two ways in which this country could make up for its past lethargy in Antarctic work and take front rank at once in this attractive field.

One is to establish a station at the South Pole for one year's continuous observations in various fields of scientific investigation.

The other is to inaugurate and carry out in a special ship, with a corps of experts, through a period of several seasons, a complete survey and study of the entire periphery of the Antarctic Continent and its bordering ocean.

We should also set before ourselves the thorough exploration of the region south of Cape Horn, the Weddell Sea region, which is especially within our sphere of influence, together with a traverse from the most southern point of that sea to the South Pole itself.

Such traverse, with the work of Amundsen, of Shackleton, of Scott, would give us a complete cross-section of Antarctica.


Bonaire
Is de Aves
Los Roques
Orchilla
Blanquilla
Los Hermanos
Cayo Grande
Is Testigos
Tobago
Scarborough
Pt Galera
Margarita
Asuncion
Tortuga
Tres Puntas
TRINIDAD
Pt of Spain
Gulf of Triste
La Guaira
CARACAS
C. Codera
Cumana
Carupano
GULF of PARIA
Galeota Pt
Guanta
Barcelona
Guanoco
Maturin
Serpent's Mouth
Baja Pt
Petare
La Victoria
Ocumare
Cura
St Carlos
St Francisco
Calabozo
R. Tigre
Delta of Orinoco
Barrancas
Imataca
Mocomoco
Tortula
River
Orinoco
Sta Cruz
Ciudad Bolivar
Los Tablas
Guri
Caniaguan
St Isidro
Fernando de Apure
La Triana
U E L A
Guacipati
El Callao
S. Pedro
R. Caroni
R. Cuyuni
Achagua
BRITISH GUIANA
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VOL. XXIV, NO. 2 WASHINGTON FEBRUARY, 1913

THE NATIONAL GEOGRAPHIC MAGAZINE

THE RECENT ERUPTION OF KATMAI VOLCANO IN ALASKA

An Account of One of the Most Tremendous Volcanic Explosions Known in History

BY GEORGE C. MARTIN

Mr. Martin is the geologist of the U. S. Geological Survey who directed the National Geographic Society Alaska volcano researches in 1912

THE volcanic eruption of Mount Katmai, Alaska, of June, 1912, was undoubtedly one of the most violent eruptions of historic times.

This volcano was one of the least known of the many Alaskan volcanic peaks, and had been so long dormant that there were apparently not even local legends of its former outbreaks. No observed warnings of its renewed activity were given other than copious steaming and minor earthquakes. These attracted little attention even among the few dwellers in that thinly settled land, for dozens of other volcanoes along the Alaskan coast steam freely from time to time. The peak is usually hidden in the clouds, and local earthquakes are so frequent as to cause little comment.

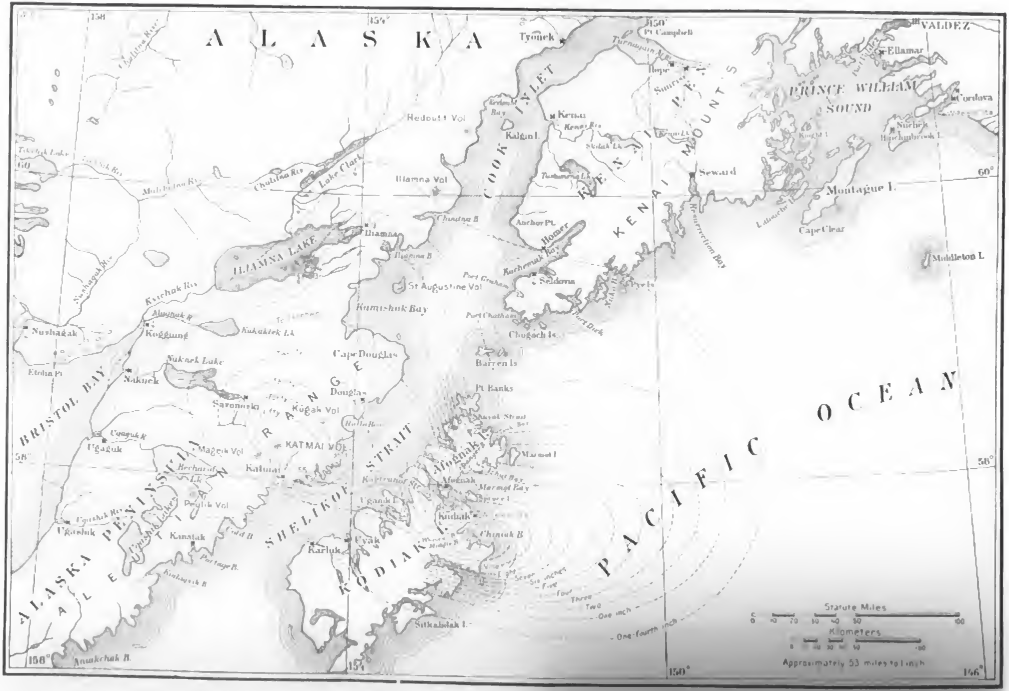
Among other people than the few local inhabitants and the comparatively few others who have had occasion to sail through Shelikof Strait, the very existence of Katmai Volcano was doubtless unknown.

Then, without warning, on the 6th of June, 1912, the Katmai Volcano proclaimed itself by a violent eruption. All southern Alaska knew of the event at once, for the sound of the first mighty explosion carried down the coast as far as Juneau, 750 miles away, and was even heard across the Alaska Range at Dawson and Fairbanks, distant 650 and 500 miles respectively.

THE FIRST ERUPTION

Those who did not hear the sound of this first blast, or did not feel the accompanying earthquakes, did not have to wait long for another form of announcement. The column of steam and ash rose several miles in the air and was immediately seen as far away as Clark Lake and Cook Inlet. This cloud of ash was carried eastward by the wind and within a few hours had shed a shower of ashes over all the east end of the Alaska Peninsula, the east half of Kodiak Island, and all of Afognak Island (see map, page 132).

Intense darkness accompanied the fall of ashes. Midnight blackness in the daytime extended as far east as the Kenai Peninsula. Darkness lasted for 60 hours at Kodiak, 100 miles from the volcano. Dust fell as far away as Juneau, Ketchikan, and the Yukon Valley, distant 750, 900, and 600 miles. The fumes were reported from points as remote as Van-



MAP OF THE REGION AFFECTED BY THE KATMAI ERUPTION, [illegible]

The thickness of ash is shown by curves of approximately equal depth and by figures showing measured depth in inches [illegible]

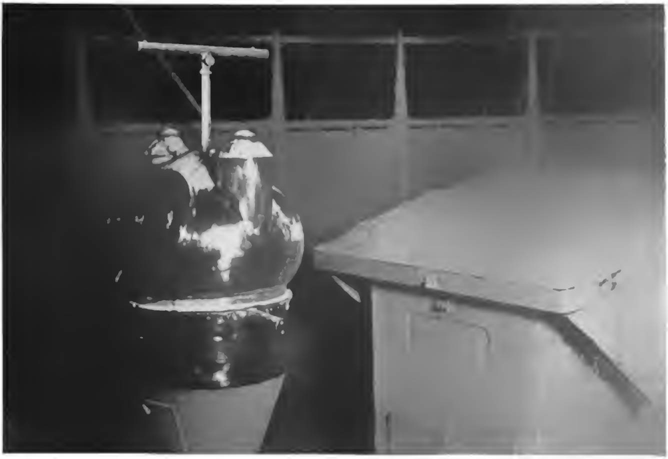


Photo by Lieut. J. F. Hahn

A FLASHLIGHT VIEW TAKEN UNDER THE OPEN SKY AT NOON, SHOWING ASH-COVERED CHART BOARD OF THE "MANNING," JUNE 8, 1912—100 MILES FROM VOLCANO

"The darkness was intense, and the ash so thick in the air that bright lights failed to penetrate it for more than a few feet. It is said that a lighted lantern held at arm's length could barely be seen, and that the searchlight of the *Manning* failed to penetrate farther than the bow of the ship" (see page 156).

couver Island and Puget Sound, 1,500 miles away.

In the violence of the explosion, in the quantity of material thrown out, and in the distance to which the ejected material and sound waves were carried, this was certainly among the greatest eruptions witnessed by man. It differs, however, from almost all other known great eruptions in that the immediate damage to property was almost nothing, and that, as far as known, it was not the direct and sole cause of the loss of a single human life.

HOW THE NEWS CAME

The stories which came by wire from the towns along the Alaska coast at this time told of an eruption of the first magnitude somewhere to the westward. These towns heard the explosion, felt the earth tremble, and saw the air clouded with dust brought in on the west wind. Still no authentic news came as to the exact origin of the disturbance. The volcano proclaimed its own news for a thousand miles down the coast, yet silenced the wireless by which the Alaska Peninsula and Kodiak Island were ordinarily in communication with the world.

The first detailed and authentic news came when the little old mail steamer *Dora*, notorious partaker in many a wild Alaskan episode, returned to Seward from her monthly Aleutian pilgrimage with her decks smeared with ashes and reported witnessing the outbreak from a near-by point and running out to sea in 24 hours of darkness and ashes. The *Dora* had been unable to reach Kodiak in the darkness caused by the volcanic cloud (see page 154).

It is highly probable that other vents in the vicinity of Mount Katmai had been steaming profusely throughout the summer, and they may at times have been in a moderate state of eruption, but all the available evidence indicates that

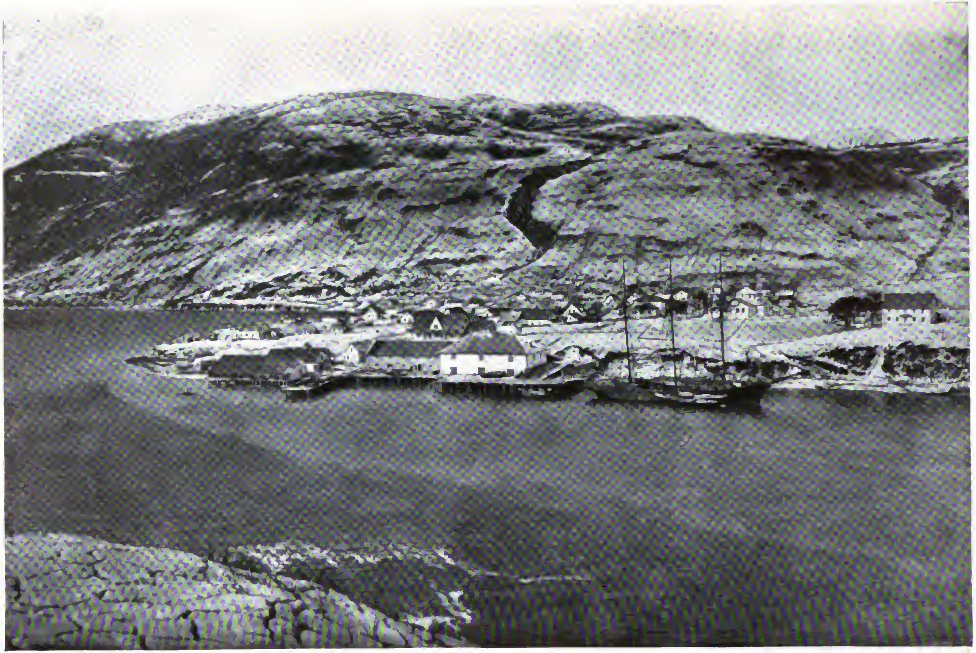


Photo by George C. Martin

THE TOWN OF KODIAK, ALASKA, AFTER THE ERUPTION OF KATMAI

The town is 100 miles from the volcano. Note the heavy deposits of white ashes covering hillsides and town. Dust fell as far away as Juneau, Ketchikan, and the Yukon Valley, distant 750, 900, and 600 miles from the volcano

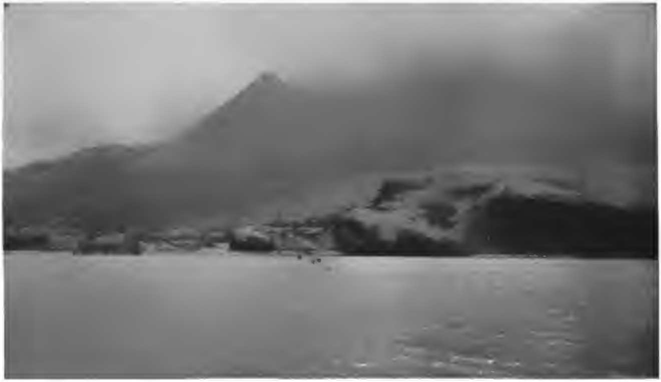


Photo by George C. Martin

VOLCANIC CLOUD POURING OVER MOUNTAIN WEST OF AMALIK BAY, 1.30 P. M., AUGUST 10, 1912

The white drifts which cover the mountain slopes are not snow, but ash and pumice from the volcano

Mount Katmai is by far the most active of the group, and is probably the only one which contributed in any large way to the great volume of solid matter ejected in June.

THE SCENE OF THE ERUPTION

Mount Katmai is a peak 7,500 feet high, situated relatively near the eastern end of the Alaska Peninsula and of the Aleutian Mountains.

The Alaska Peninsula is like a great horn, convex on the southern side, 500 miles in length, averaging 50 miles in width, and projecting southwestward from the Alaska mainland. It has a partly submerged extension in the Aleutian Islands which stretches 1,100 miles westward toward Asia, and with these separates Bering Sea from the Pacific.

The Aleutian range, like the less continuous line of peaks on the islands trailing from it, is dominantly volcanic throughout, there being certainly nine, and probably at least twelve active or latent volcanoes in the Alaska continental end of the belt. The Aleutian Islands probably contain a still larger number of volcanoes. Only two of the Alaska volcanoes, Wrangell and Edgecombe, are not situated in these groups (see page 136).

The mountains in this belt which have shown indications of volcanic activity in historic times include Redoubt, Iliamna, and St. Augustine, on Cook Inlet. Redoubt was active in January, 1902, while St. Augustine had an exceptionally violent eruption in October, 1883.

The easternmost volcano known on the Alaska Peninsula is Mount Kugak, which was probably active in 1889. Mount Katmai comes next to the westward, and has a near neighbor, Mount Mageik, which seems to have shared, in a more moderate way, its recent activity. There are probably other unnamed volcanoes in the near vicinity.

Veniaminof, near Chignik, was in eruption on August 28th, 1892, this outbreak apparently being, next to those of Katmai and of St. Augustine, the most violent known in Alaska. Farther west and near the extremity of the Alaska Peninsula is Mount Pavlof, which has been continuously steaming for many years.

The volcanoes of the Aleutian Islands include a well-known group at the eastern end in which are Isanotski, Shishaldin, Pogromni, Akutan, and Bogoslof.

MOUNT EDGECOMBE AND SITKA

The town of Sitka is historically the most notable settlement in Alaska. It was founded as Fort Archangel Gabriel by the Russians in 1799, about 6 miles from the present site, to which the move was made in 1804, and was transferred to the United States in 1867. The town and its inhabitants preserve many Russian characteristics, and it is still the see of a Russian orthodox bishop. Its climate is more equable than that of Ottawa and its annual temperature higher. Mount Edgecombe is a volcano 3,467 feet high

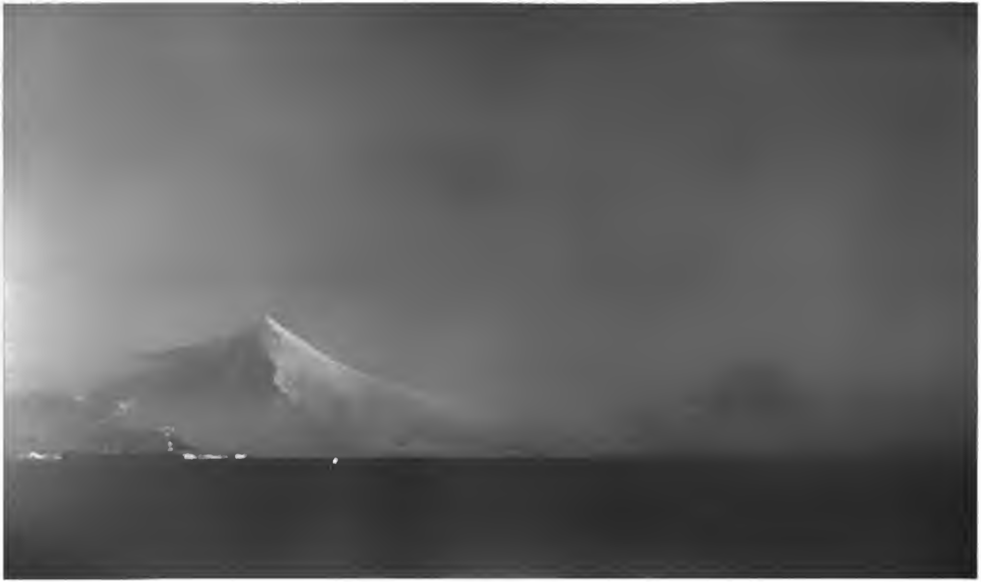


Photo and copyright by John E. Thwaites

SHISHALDIN VOLCANO, 9,387 FEET HIGH

This volcano is situated on the first of the series of islands which stretch out from the end of the Alaska Peninsula towards Asia across the Bering Sea. The volcanoes on these islands are exceedingly difficult to photograph, as this region is constantly enshrouded in thick fog or mist.

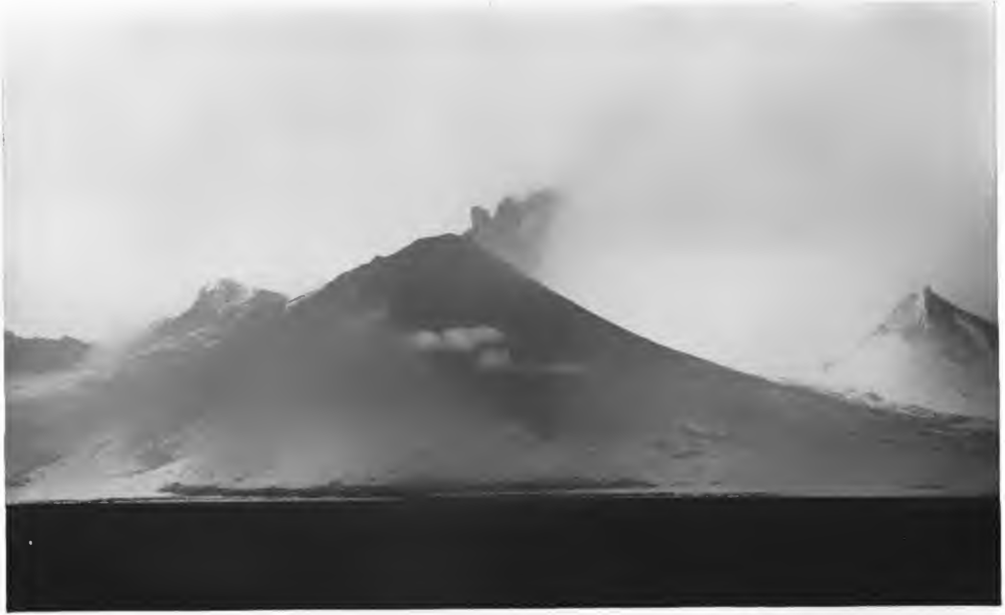


Photo and copyright by John E. Thwaites

THE BEAUTIFUL CONE OF PAVLOF VOLCANO

This active volcano stands at the head of a deep, land-locked bay near the western extremity of the Alaska Peninsula, at a distance of about 315 miles from Katmai

Photo by George C. Martin

CANNERY OF ALASKA PACKERS' ASSOCIATION AT LARSEN'S BAY, KODIAK ISLAND, AUGUST 23, 1912

A small amount of ash fell here, but the grass was not covered, and no serious damage was done except to the fish, which were frightened away

and a large number of others situated farther to the west.

Shelikof Strait, a turbulent and treacherous body of water, averaging 35 miles in width, lies south of the eastern end of the Alaska Peninsula and separates it from Kodiak and Afognak islands, which shared the effects of the eruption with the eastern end of the Alaska Peninsula. These islands are mountainous, but not volcanic.

THE INHABITANTS OF THE ALASKA PENINSULA

The inhabitants of the Alaska Peninsula include a few hundred people in ten or twelve small native villages, the employés of four or five salmon canneries, and a handful of traders and prospectors. Most of the native villages had a former basis of prosperity in sea-otter hunting, but with the practical extinction of the sea otter this is gone and the salmon is the chief means of support.

The inhabitants of Kodiak and Afognak islands are mostly descendants of Russians. The largest settlements are Kodiak (St. Paul) and Afognak. The former is well known as one of the quaintest and most attractive towns on the Alaskan coast. Its population includes the largest proportion of Americans of any

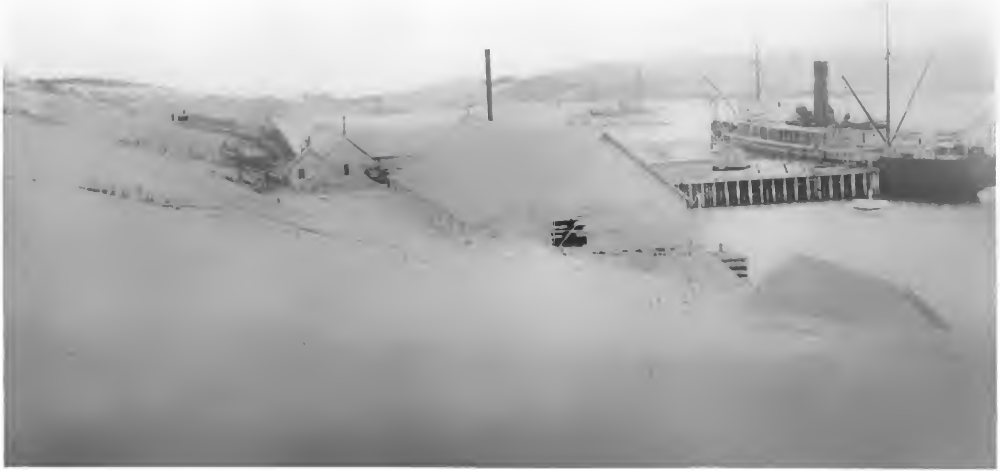


Photo by P. S. Hunt

KODIAK FISHERIES CANNERY, COVERED WITH 10 INCHES OF ASH FROM KATMAI VOLCANO, WHICH IS 100 MILES AWAY town in southwestern Alaska. The town had long lived upon the memories of its former glories as capital during the early Russian occupation and of the prosperous sea-otter days. New activities have recently come through the establishment of salmon and halibut fisheries and of important agricultural industries.

It was the sparse settlement of the district which alone prevented great loss of life during the recent eruption.

The town of Katmai was deserted at the time of the eruption, most of the inhabitants being at Kaflia Bay, 30 miles east of the volcano.

THE NATIONAL GEOGRAPHIC SOCIETY'S INVESTIGATION

As soon as it became known that there had certainly been a great eruption in southwestern Alaska the Research Committee of the National Geographic Society made plans for the investigations upon which this article is based. This expedition is the beginning of a systematic study of the Alaskan volcanoes which the National Geographic Society has in view and which will be carried out by some experienced authority on volcanism. The writer was selected for this first expedition not as a student of volcanism, but as one who eight years before, in the course of the U. S. Geological Survey's investigations, had made a cruise of 300 miles in an open boat along this little-known coast, and was consequently somewhat familiar with the local geographic details.

A hurried departure from Washington, a busy day of outfitting in Seattle, and a leisurely voyage of 13 days past all the windings of the sinuous southern coast-line of Alaska preceded an arrival in Kodiak just four weeks after the eruption began. The protracted voyage from Seattle had its compensation in that it permitted visits to many places which had been affected by the eruption and interviews with many eye-witnesses.

On reaching Kodiak it was found that the revenue cutter *Manning* was still in port and was about to move the refugees from the uninhabitable mainland villages to a new location west of the affected zone. Capt. K. W. Perry kindly welcomed the writer as a passenger on this and following cruises of the *Manning*. The four weeks spent aboard the *Manning* permitted the obtaining of vivid accounts of the hours of darkness which the officers of the cutter witnessed at Kodiak, and of their subsequent observations in the vicinity of the volcano and elsewhere, and also gave opportunity to see parts of the coast which would otherwise have been inaccessible.

After leaving the *Manning*, the power schooner *Lina K.* was chartered and cruises were made along the southeast shore of Afognak Island and the northwest shore of Kodiak Island, the effects of the eruption being thus studied in detail. While in Shelikof Strait watch was kept for a glimpse of the volcano, but the clouds hung continuously upon the mountain.

On August 8 the clouds seemed breaking and the sea was smooth, so we crossed to Amalik Bay on the mainland. Vast columns of steam could be seen rising through the clouds, but the latter were not dispelled enough to permit a satisfactory view. Two weeks were spent on the mainland between Amalik and Cold bays. During this time many interesting phenomena, described below, were observed, but the glimpse of the volcano itself, which was desired most of all, was not obtained.

The part of Alaska in which Mount Katmai is situated and the districts most seriously affected by the eruption are so thinly settled that the number of persons who observed the eruption and its larger effect is comparatively small. The writer has been able to get in touch directly or indirectly with most of these people, and they have furnished information of very great value which could not otherwise have been obtained.

CONDITIONS PRECEDING THE ERUPTION

Mount Katmai had been in a dormant condition for an unknown length of time, but for many months prior to its outburst it must have been going through the changes which a dormant volcano always undergoes prior to an eruption.

A volcano consists of a vent extending from the surface of the earth to a

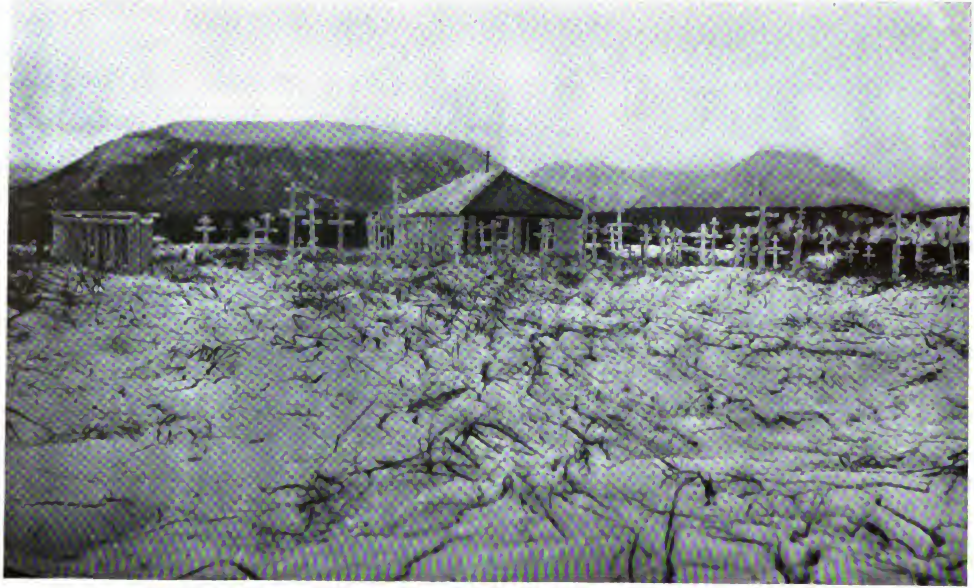


Photo by George C. Martin

CHURCH AND GRAVEYARD AT DOUGLAS VILLAGE, JULY 14, 1912: NOTE THE BEACH GRASS GROWING UP THROUGH CRACKS IN 11 INCHES OF ASH reservoir of molten material deep in the earth's crust. The vent usually reaches the surface at the summit of a mountain, composed of material thrown out in earlier eruptions and terminates above in the opening known as the crater. When the volcano is not in eruption this vent is closed by material fallen in from above and by material which was not fully expelled during preceding eruptions and solidified there.

WHAT CAUSES AN ERUPTION

An eruption is preceded by a long continuing and gradually increasing accumulation of pressure from the reservoir of molten material. The eruption is caused by this pressure becoming at last sufficient to overcome the resistance of the material which chokes the vent, or by a sudden relief of pressure by faulting or some other cause. The conditions preceding the eruption include a gradual rise of lava in the vent, accompanied by an increase in the temperature of the surface rocks, an increase in both temperature and volume of the waters and gases given out, and by earthquakes and minor explosions.

The initial outburst is accompanied by the final clearing of the vent and breaking up and expulsion of the detritus and solidified lava by which it had been closed and sometimes by the destruction of the mountain. This suddenly relieves the underlying liquid lava of an enormous pressure, and results in the rapid giving off of the steam and other gases which the lava contained.

Hot molten lava, especially when under pressure, has the capacity to dissolve great volumes of gas. It is in the condition of water under pressure and charged with gas. The uncorking of the volcano has therefore the same effect as the uncorking of a bottle of any other liquid charged with gas; the gas rushes out, carrying part of the liquid material, chiefly in the form of coarse spray.

It is this frothing of the lava which creates pumice, which is nothing but lava blown full of holes and projected in a liquid condition into the air, where it cools. The explosion which began is then continued in great force with the ejection of a stream of lava-spray or liquid pumice, which is kept up as long as the imprisoned gases last.

This action is usually intermittent, the volcano behaving somewhat as a geyser and being subject to the effects of repeated accumulation and sudden release of pressure from below. In most cases, after the larger part of the gas is given off, the lava flows quietly out in response to the pressure back of it.

HOW SHOWERS OF ASHES ARE FORMED

The column of steam and lava-spray, after being blown out of the crater, expands until it is in so rarefied a condition that it floats freely in the air and is known as volcanic smoke. This gradually cools, and in so doing becomes unable to support the solid particles which gradually fall in a shower of ash and dust. These finer materials are composed chiefly of the smaller particles of spray as they solidified, together with detrital material made up of fragments broken from the walls of the crater by the passing blast, and of pumice dust made by the larger pieces breaking as they struck each other or cracking as they cooled.

The eruption of Mount Katmai was doubtless preceded by the conditions described above, yet in this case, probably because of the absence of near-by observers, none of them except the earthquakes were recorded. Earthquakes were felt at Katmai for at least five days prior to the eruption, while more severe shocks were felt on June 4 and 5 at Kanatak, Uyak, and Nushagak. These places are 65, 58, and 130 miles from Mount Katmai to the southwest, southeast, and northwest respectively.

It seems highly probable that the volcano began to throw out large volumes of gases on the 5th, since observers at Cold Bay noted that the northern sky in the direction of the volcano "looked black and storming" late that night, in spite of the fact that there was fair weather on the coast.

THE EXPLOSIONS THAT WERE HEARD 900 MILES AWAY

Early in the afternoon of June 6 the volcano passed into a state of violent eruption. There must have been fre-

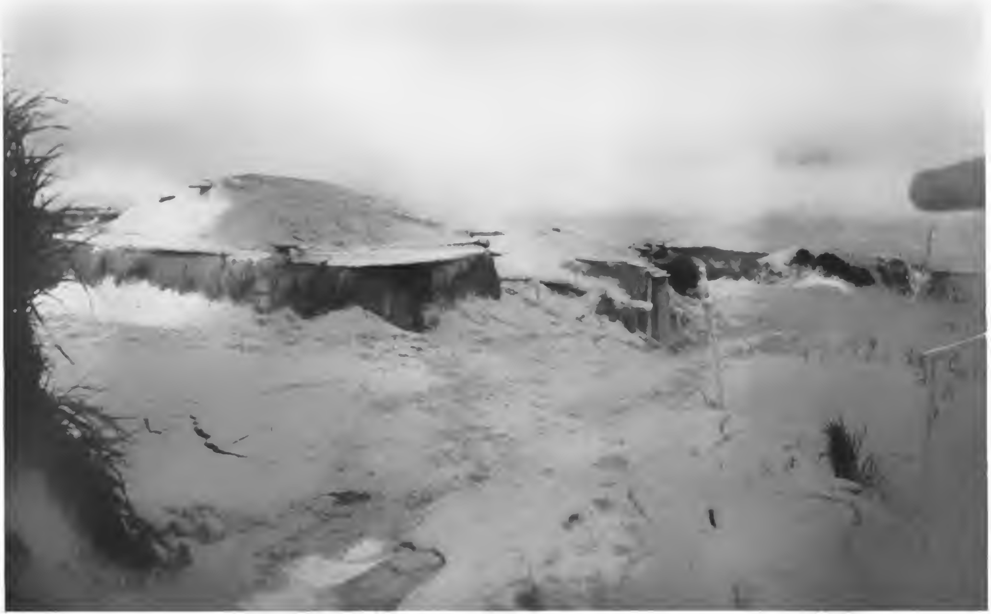


Photo by George C. Martin

BARABARAS AT DOUGLAS VILLAGE, JULY 14, 1912

A barabara is the name given by the Aleuts to their huts, which are built half underground and roofed with soil. Those shown in the picture were almost buried beneath the tremendous shower of ashes from Katmai

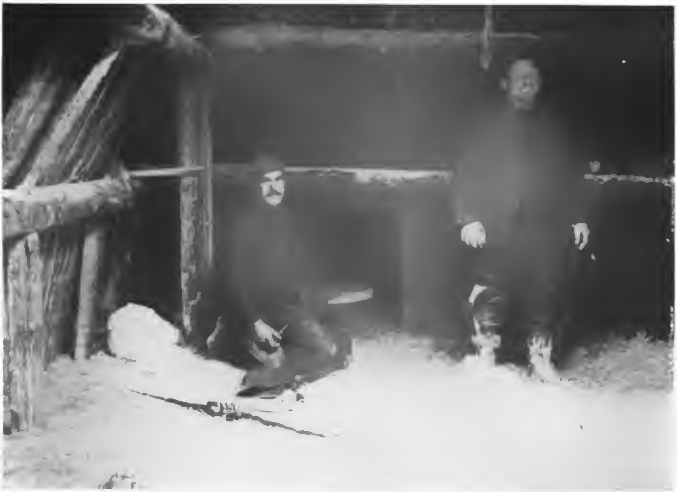


Photo by George C. Martin

INTERIOR OF MAIN ROOM OF BARABARA AT DOUGLAS VILLAGE, SHOWING HOW THE ASH PENETRATED THE CREVICES AND CRACKS

quent explosions accompanied by earthquakes during the morning, but few of these were intense enough to be noticed at a distance. It was only at Seldovia and Nushagak that these preliminary morning explosions were noted.

The beginning of the violent phase of the eruption was apparently at 1 p. m., June 6, at which time a terrific explosion and earthquake was noted by C. L. Boudry at Cold Bay (see page 147). At the same hour a heavy cloud was seen from the steamer *Dora* (55 miles away) rising over Mount Katmai. This cloud was under observation from this time until it enveloped the steamer, 5½ hours later. The accompanying views of the cloud were taken by John E. Thwaites, mail clerk of the *Dora*, just before darkness shut down (see pages 154, 155).

At 3 p. m. there was a tremendous explosion, which was heard for hundreds of miles around, and the volcano passed into a state of continuous eruption, which lasted, except for possible short intervals, for several days.

This explosion was noted at Uyak, at Iliamna Bay, at several places on Iliamna and Clark lakes, at Koggiung, and at a point 90 miles southwest of Eagle. Explosions were also heard at about this time, although no statement of the exact hour is available, at Juneau, 750 miles east, and Fairbanks, 500 miles northeast of the volcano. At Iliamna Bay the sounds were accompanied by a "sudden, quick motion of the clouds that would start and stop."

It was probably at this time that the larger part of the coarse, gray ash which forms the lower stratum on the Alaska Peninsula and on Kodiak and Afognak islands was thrown in the air. This ash reached Uyak, 58 miles away, at 3.30 p. m., and Kodiak, 100 miles from the volcano, at 5 p. m., and soon afterward complete darkness settled down over an area of several thousand square miles.

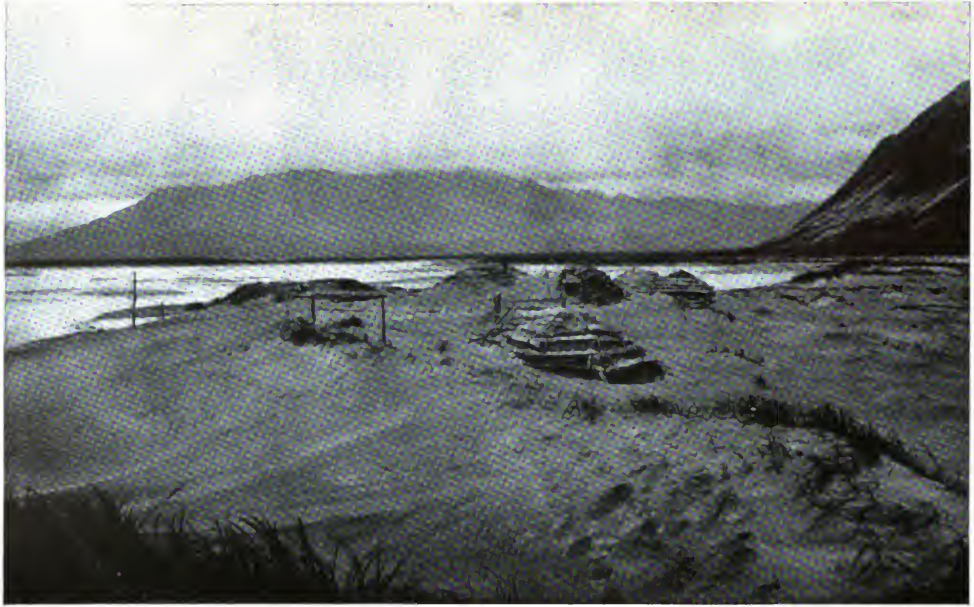


Photo by George C. Martin

KATMAI VILLAGE, LOOKING NORTH TOWARD KATMAI VOLCANO, WHICH IS CONCEALED IN THE CLOUD BEYOND THE HILLS
AUGUST 13, 1912

The eruption of Katmai Volcano, though one of the most violent explosions recorded, did not cause the loss of a single life, owing to the sparse settlement of the neighborhood. The town of Katmai was deserted at the time of the eruption, most of the inhabitants being away, engaged in the summer fishing.

EYE-WITNESSES OF THE ERUPTION

The only people who witnessed the explosion from near at hand were natives. Two families, who stayed at Katmai after the other people of that town went away to work in a fishing camp, left Katmai for Cold Bay on June 4, and were in camp on the shore between Kamvik and Alinchak bays at the time of the eruption.

C. L. Boudry, who was at Cold Bay when these people reached there wrote in his diary: "They report the Katmy hill blew up and threw rock out to sea, but could not tel mor as they whare on the road to Cold Bay—an that pommey stone in fire whas falling 20 miles an that the watter was hot in the Katmy bay—after examining ther boat ther i found pummice stone the sise of common rice."

Jack Lee, who also interviewed them on their arrival at Cold Bay wrote: "They report the top of Katma Mountain blun of. There was a lot of Pummy stone in their dory when they got here and the say Hot Rock was flying all eraund them."

These last two statements of the interviews with the natives are quoted verbatim because each contains an assertion that the explosion wrecked the mountain. In this connection it is important to note the statement made by William Neilson, of Iliamna, as quoted in a letter from Thomas W. Hanmore. Mr. Hanmore says: "While Mr. Neilson was in Naknek" (he went there June 7, and was there at least until June 9) "the natives from the Indian village of Savanoski, at the head of Naknek Lake, came to Naknek very much excited. They reported the upper half of Katmai Mountain gone and the mountain burning up."

These people, together with those from Katmai, were the nearest persons to the volcano at the time of the eruption, and were in an excellent position to observe what happened. Proper allowance must, of course, be made for the natural but unintentional exaggeration due to the excitement of the moment; but the close similarity of these entirely independent accounts, their source from people who, though familiar with dormant volcanoes, certainly never before witnessed a violent eruption, and their agreement with what we would expect to happen in an eruption of this character, all confirm them as being probably reliable and accurate descriptions of what occurred at 3 p. m., June 6, as seen by the only eye-witnesses.

THE SECOND EXPLOSION

The activity of the volcano probably slackened somewhat after the severe outbreak at 3 p. m. The next violent explosion was probably at about 11 p. m. that night, at which time a hard earthquake was noted at Cold Bay and at about which time a strong glare of light was observed at Kanatak (see page 148).

It is believed to be the ash of this eruption which began falling at Kodiak about noon of June 7, at Afognak at 4 p. m. of the same day, and at the west end of the Kenai Peninsula early the morning of the 8th. This shower continued without interruption at Kodiak for 26 hours, or until 2.30 p. m., June 8. The ash which fell during this shower is the second stratum of fine brown material 4½ inches thick at Kodiak after being packed down.

The people at Cold Bay apparently first realized that a volcano was in violent eruption on the morning of June 7. The westerly wind on the 6th kept any ash from reaching Cold Bay, and apparently neither the earthquakes nor the black cloud in the northern sky had been considered as having any connection with the long dormant volcanoes. By the morning of the 7th the continued and increasing noise of thunder and explosions, together with the growing violence of the earthquakes, called closer attention to the appearance of the cloud, which had then risen to a great altitude and assumed a well-marked form and other characteristics which made it impossible to confuse it with an ordinary storm-cloud.

Father Patelin, who was at Kanatak, noted that the smoke came and dust fell there the morning of June 7, though the wind continued to be from the west. There were earthquakes nearly all day, with short intervals between. Many of the earthquakes were strong and there was continuous rumbling. The earthquakes became so severe toward evening that it seemed dangerous to remain in the barabaras, one of which nearly fell in, so they were abandoned and tents used. That evening after 10 o'clock came the strongest earthquake yet felt, accompanied by heavy rumbling and rock-slides from all around. There was evidently a strong glare of light from the volcano, it being recorded that "the mountains were like sunshine." After midnight he heard a "big noise like thunder from the Katmai side," after which everything was quiet and he slept.

THE THIRD EXPLOSION

It is important to note the very severe earthquake which was felt at Cold Bay at 10.40 p. m. June 7, and also at Kanatak at about the same hour. At Kanatak heavy rumbling was heard and an intense flare of light came from the direction of the volcano. Earthquakes lasted all this night at Iliamna Bay (115 miles distant from Katmai Volcano), it being recorded that "the earth never ceased to move for nearly 12 hours." Earthquakes were reported from 90 miles southwest of Eagle at 11 p. m. June 6 or 7. It is evident that these phenomena marked another violent outbreak of the volcano. Probably it was the material erupted during this period which forms the uppermost stratum at Kodiak and vicinity, falling there during the night of June 8.

The period of explosive activity and of the ejection of large quantities of solid matter seems to have ceased on June 8, the volcano then passing into a less violent but freely erupting stage which lasted all summer and possibly still continues. An immense column of steam was noted rising from the volcano wherever the absence of clouds permitted a view in that direction. Frequent earthquakes were noted on the Alaska Peninsula at intervals throughout the summer; heavy rumblings were heard by all who approached the vicinity; so-called flames were observed from Bristol Bay; fumes were noted at long distances from the mountain, and occasional light showers of ashes fell as far away as Nushagak. These subsequent phenomena will be described more fully after we have considered the conditions existing during the fall of ash from the eruptions already described.

THE ZONE OF DARKNESS AND FALL OF ASHES

The material hurled into the air by the explosions described above ascended to great heights and traveled east under the influence of the prevailing wind in a succession of clouds. The coarser material began to fall at once, but so great was the total volume of material that the clouds traveled several hundred miles before very considerable amounts of dust had ceased to fall and before they ceased to spread absolute darkness over the land and sea. The track of the clouds seems to have been to the east over the southeast end of Kodiak Island and out to the sea for an unknown distance, then back under the influence of a wind shifting into the east, so that Cook Inlet, Iliamna Lake, and Bristol Bay received a belated shower. The influence of the west wind at the time of the eruption on the distribution of ash is shown by the fact that the total amount of ash which fell at Cold Bay, only 50 miles from the volcano, was less than that which fell at Seldovia, 150 miles away, and probably was little if any more than that which fell at Juneau, which is 750 miles distant.

The nearest to the volcano of those within the zone of darkness were the natives in a fishing camp at Kaflia Bay. Ivan Orloff, the creole Tyone of Afognak, who was with these people, wrote as follows to his wife:

> KAFLIA BAY, *June* 9, 1912.
>
> MY DEAR WIFE TANIA:
>
> First of all I will let you know of our unlucky voyage. I do not know whether we shall be either alive or well. We are awaiting death at any moment. Of course do not be alarmed. A mountain has burst near here, so that we are covered with ashes, in some places 10 feet and 6 feet deep. All this began on the 6th of June. Night and day we light lamps. We cannot see the daylight. In a word, it is terrible, and we are expecting death at any moment, and we have no water. All the rivers are covered with ashes. Just ashes mixed with water. Here are darkness and hell, thunder and noise. I do not know whether it is day

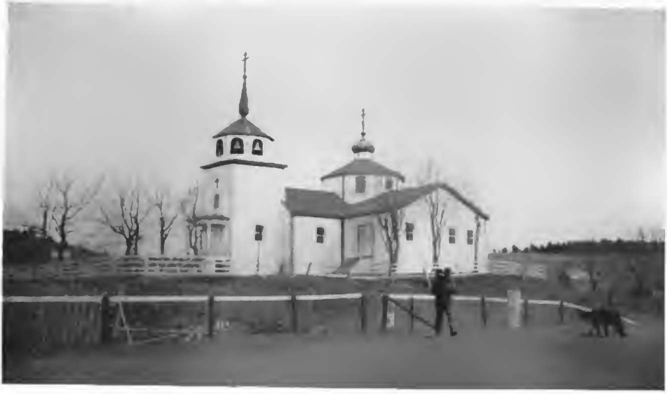
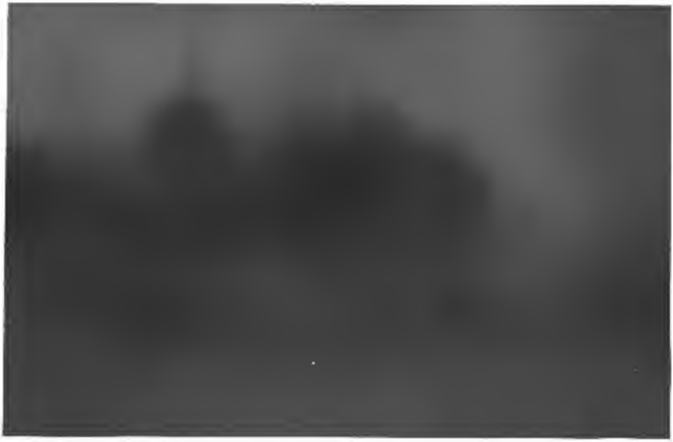
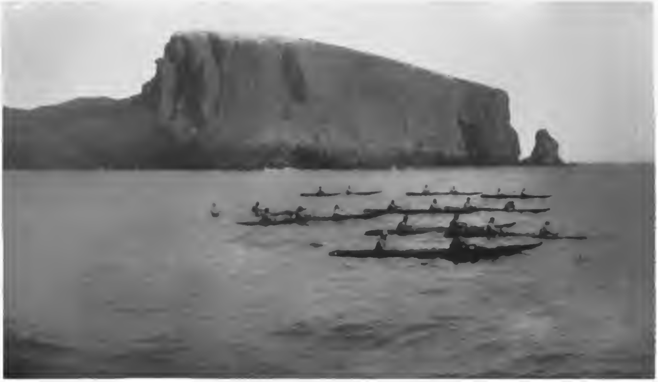


Photo by John E. Thwaites

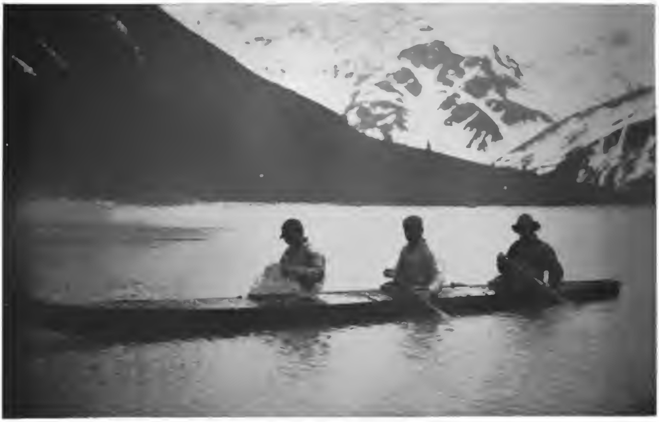
NATIVE CHURCH AT KODIAK BEFORE THE ERUPTION OF MOUNT KATMAI



THE SAME SCENE DURING THE ERUPTION OF MOUNT KATMAI, JUNE 6, 1912, SHOWING THE GREAT DRIFTS OF VOLCANIC ASHES



LAST SEA-OTTER HUNT, UNGA



BIDARKA IN ILIAMNA BAY

These bidarkas are used in the pursuit of otters. They vary from 18 to 25 feet in length and are very light, being constructed of hides stretched over a slight wooden framework. They can be very rapidly propelled and are constructed to carry one to three people with never more than three paddles.

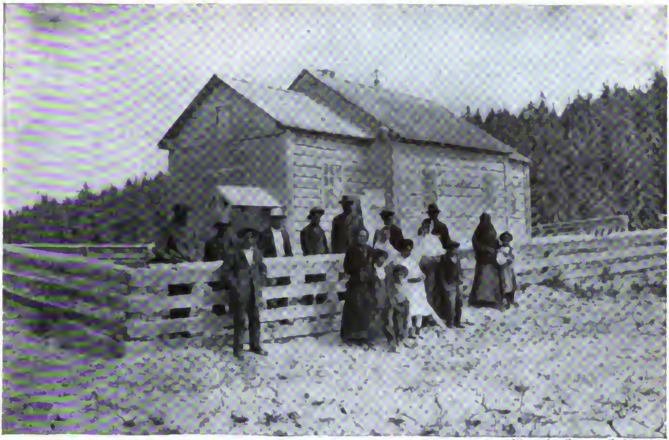


Photo by George C. Martin

RUSSIAN CHURCH AND INHABITANTS OF LITTLE AFOGNAK, JULY 30, 1912

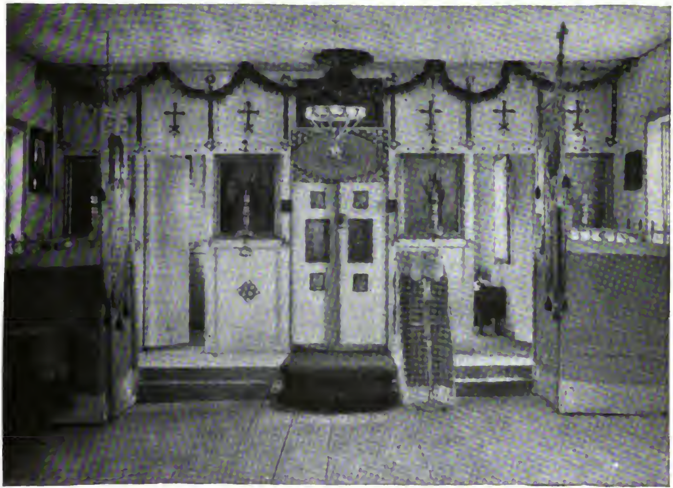


Photo by George C. Martin

THE INTERIOR OF THE RUSSIAN CHURCH AT LITTLE AFOGNAK, JULY 30, 1912

The inhabitants of Little Afognak are mainly descendants of Russian settlers and belong to the Orthodox Church or night. Vanka will tell you all about it. So kissing and blessing you both, good-bye. Forgive me. Perhaps we shall see each other again. God is merciful. Pray for us.

Your husband, IVAN ORLOFF.

The earth is trembling; it lightens every minute. It is terrible. We are praying.

WHAT WAS SEEN FROM A PASSING STEAMER

The outburst on the afternoon of June 6 was witnessed from the steamer *Dora*, which was then passing through Shelikof and Kupreanof straits, eastbound. Capt. C. B. McMullen, of the *Dora*, has given the following description of the phenomena which he observed:

"Left Uyak at 8.45 a. m., June 6; strong westerly breeze and fine clear weather. At 1 o'clock p. m., while entering Kupreanof Straits, sighted a heavy cloud of smoke directly astern, raising from the Alaska Peninsula. I took bearings of same, which I made out to be Katmai Volcano, distance about 55 miles away. The smoke arose and spread in the sky, following the vessel, and by 3 p. m. was directly over us, having traveled at the rate of 20 miles an hour.

"At 6 p. m. passed through Uzinka Narrows, fine and clear ahead, and continued on expecting to make Kodiak. At 6.30 p. m., when off Spruce Rock, which is about 3½ miles from Mill Bay Rocks and the entrance to Kodiak, ashes commenced to fall and in a few minutes we were in complete darkness, *not even the water over the ship's side could be seen.*

"I continued on in hopes that I might pick up entrance to Kodiak, but when vessel had run the distance by the log conditions were the same, so I decided to head out to sea and get clear of all danger. At 7.22 I set a course NE. by N. (magnetic). Wind commenced to increase rapidly now from the southwest and vessel was driven before it. Heavy thunder and lightning commenced early in the afternoon and continued through the night. Birds of all species kept falling on the deck in a helpless condition. The temperature rose owing to the heat of the volcanic ash, the latter permeating into all parts of the ship, even down into the engine-room.

"About 4.30 a. m. next day vessel cleared the black smoke, emerging into a fiery red haze, which turned into yellow, and by 6 a. m. the ashes had ceased to fall and the horizon was perfectly clear from west to north.

"The wind now came from the northwest and vessel was headed for Chugach Islands, as the smoke and ash was still in the sky astern of us.

"During the day Katmai continued to be emitting volumes of smoke and could be seen at a distance of over 100 miles.

"The vessel was covered with ash from trucks to deck, the decks having ashes from 4 to 6 inches deep.

"Made Seldovia June 7 at 8 p. m. and Homer at 11 p. m. Leaving Homer at 11.30 p. m., proceeded on toward Seward. At 3.30 to 4 a. m. passed through bank of volcanic ash. At 7 a. m. vessel was in complete darkness again and I dropped the anchor near Clam Bay until 9.20; clearing a little, proceeded again and run out to sea. At 10 a. m. complete darkness again, which continued throughout the day until 4 p. m., when we ran out of the smoke area into brilliantly clear weather."

THE RAIN OF ASHES

John E. Thwaites, mail clerk on the *Dora*, was quoted in a local paper as saying that at 1 p. m. an immense column of smoke was seen ascending from the westward, its diameter seeming to be at least half a mile or a mile. The column rapidly became dimmer, and a dark mass of cloud showed above it, mingled with it, and came toward the steamer. Soon the cloud obscured the column altogether, and afterward lightning was seen in the cloud. At 4 p. m. the edge of the cloud was directly overhead and the pictures were taken (see pages 154, 155).

As the sun passed behind the edge of the cloud at this time, it immediately began to grow dark. At 5 o'clock lights were turned on. At 6 o'clock the advance edge of the cloud was out of sight beyond the horizon, and small white flakes began to fall. Darkness gradually increased as the streak of clear sky in the northwest narrowed, until "when the last ribbon of clear sky was suddenly ob-

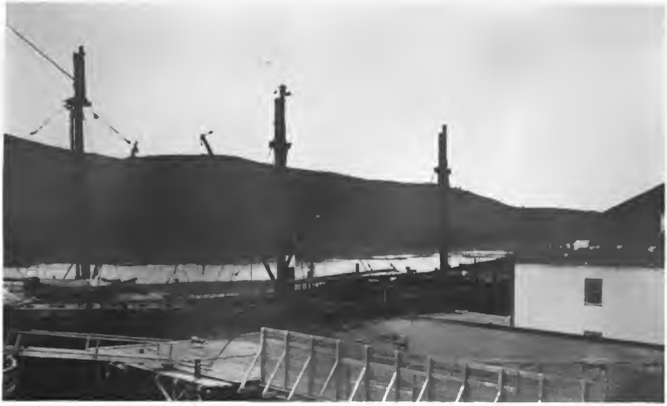


Photo by W. J. Erskine

BARGE "ST. JAMES" AT KODIAK, JUNE 4, 1912, BEFORE THE ASH FALL

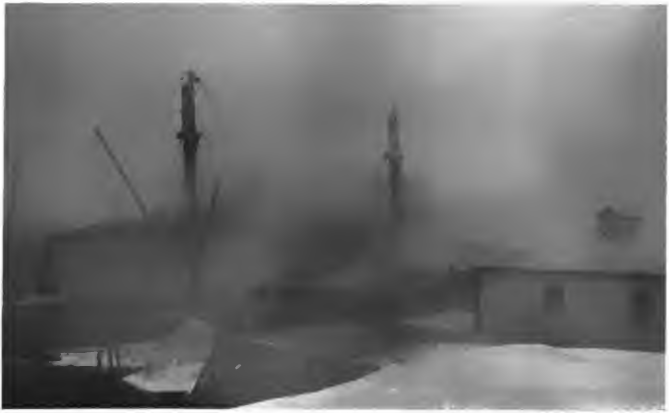


Photo by W. J. Erskine

THE "ST. JAMES" AT KODIAK, JUNE 9, 1912, AFTER THE ASH FALL

"The buildings of the Navy wireless station, on Wood Island, were struck by lightning and burned on the evening of the 7th or the morning of the 8th. The darkness at the time was so intense that the flames could not be seen from the mission, less than ¼ mile away. Late in the afternoon of June 8 partial daylight appeared and the fall of ash almost ceased" (see page 156). There was darkness for practically 60 hours, at a distance of 100 miles from Katmai Volcano (see page 165).

Photo and copyright by John E. Thwaites

EDGE OF VOLCANIC CLOUD, LOOKING SOUTHWEST FROM THE "DORA," 75 MILES FROM VOLCANO (SEE PAGE 133)

scured, the light snuffed out like a candle and we were left in absolute darkness."

Mr. Thwaites' further statement of conditions during the darkness and fall of ashes on night of June 6, as published in the *Seward Gateway* of June 15, is as follows:

"And now began the real rain of ashes; it fell in torrents; it swirled and eddied. Gravity seemed to have nothing to do with the course of its fall. The under side of the decks seemed to catch as much ashes as the sides or the decks under our feet. Bright clusters of electric light could be seen but a few feet away, and we had to feel our way about the deck. The officers of the deck had to close the windows of the pilot-house tightly, and even then it was with the greatest difficulty that the man at the wheel could see the compass, through the thick dust that filled the room. In the meantime, lurid flashes of lightning glared continuously round the ship, while a constant boom of thunder, sometimes coinciding with the flash, increased the horror of the inferno raging about us. As far as seeing or hearing the water, or anything pertaining to earth, we might as well have been miles above the surface of the water. And still we knew the sun was more than two hours above the horizon.

"In the saloon everything was white with a thick layer of dust, while a thick haze filled the air. The temperature raised rapidly, and the air, what there was left of it, became heavy, sultry, and stifling. Below deck conditions were unbearable, while on deck it was worse still. Dust filled our nostrils, sifted down our backs, and smote the eye like a dash of acid. Birds floundered, crying wildly, through space and fell helpless to the deck."

BLACKNESS OF NIGHT AT MIDDAY

The events at Kodiak during the eruption, including the appearance of the black volcanic clouds, the rain of ashes, the 60 hours of almost continual darkness, the precautions taken for the safety of the people, and the welcome return of clear skies, have already been vividly described in these pages by Captain Perry, of the revenue cutter *Manning*,* and will not be repeated in detail here.

The volcanic clouds were first noticed about 4 p. m., June 6, in the south and west. Another cloud afterward appeared in the north, the two meeting in the northeast. Ash began to fall at 5 p. m., coming in gradually increasing volume. At 7 p. m. complete darkness had shut down. Thunder and lightning were observed soon after the cloud appeared, and

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*(See NATIONAL GEOGRAPHIC MAGAZINE, vol. XXIII, No. 8, pp. 824-832.)

Photo and copyright by John E. Thwaites

VOLCANIC ASH APPROACHING KODIAK ISLAND

Photograph taken straight up from deck of the *Dora*, June 6, 1912

Photo and copyright by John E. Thwaites

SMOKE FROM KATMAI VOLCANO AS IT PASSED OVER KODIAK ISLAND

Photograph taken straight up from deck of the *Dora* June 6, 1912

"The column rapidly became dimmer, and a dark mass of cloud showed above it, mingled with it, and came toward the steamer. Soon the cloud obscured the column altogether, and afterward lightning was seen in the cloud. . . . As the sun passed behind the edge of the cloud at this time, it immediately began to grow dark. . . . 'The last ribbon of clear sky was suddenly obscured, the light snuffed out like a candle, and we were left in absolute darkness.'" (see pages 152, 154).

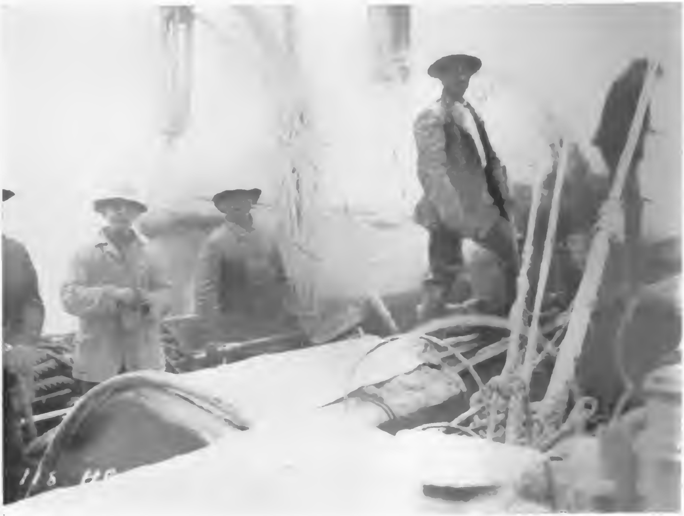


Photo by H. C. Hermann

ON BOARD THE "MANNING" AT KODIAK, JUNE 8, 1912

continued in great severity throughout the rain of volcanic material, but diminished in intensity after midnight of the 6th.

The lightning was described by one observer as traveling like a snake and in some cases as going up from the earth in round balls. Electrical conditions were such that wireless apparatus could not be used. A number of severe earthquakes were felt during the night.

Ash fell continuously until 9.10 a. m., June 7, but in decreasing volume after 3 a. m. The total fall of ash up to this time was originally about 5 inches, but packed down afterward to 4 inches, forming the lower and coarse gray stratum now on the ground (see page 166).

THICK DARKNESS AND A RAIN OF ASHES FOR OVER 25 HOURS

At noon, June 7, the fall of ash was renewed. At 1 p. m. darkness came again, not to be dispelled until after 2.30 p. m. of the following day. During all this time the fall of ash was continuous and was accompanied at times by sulphurous fumes. *The darkness was intense, and the ash so thick in the air that bright lights failed to penetrate it for more than a few feet.* It is said that a lighted lantern held at arms length could barely be seen, and that the searchlight of the *Manning* failed to penetrate farther than the bow of the ship. By the morning of the 8th the ash had accumulated in sufficient bulk on the steep hillsides to begin sliding in great volumes.

The buildings of the Navy wireless station on Wood Island were struck by lightning and burned on the evening of the 7th or the morning of the 8th. The darkness at the time was so intense that the flames could not be seen from the mission, less than ¼ mile away. Late in the afternoon of June 8 partial daylight appeared and the fall of ash almost ceased. The ash which fell during this

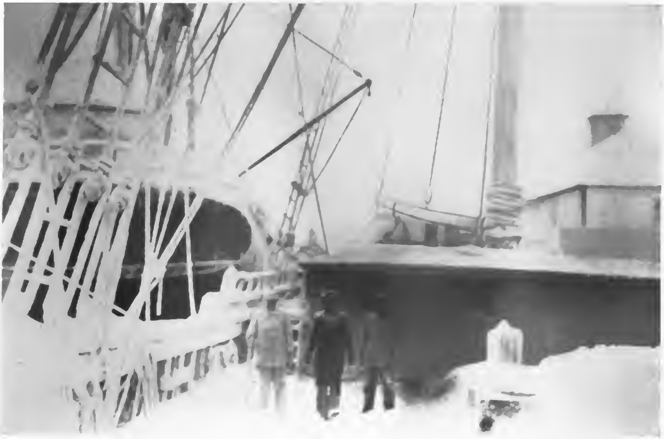


Photo by W. J. Erskine

THE END OF THE ASH FALL AT KODIAK: SCHOONER "METHA NELSON" AND BARGE "ST. JAMES," JUNE 9, 1912

time constitutes the second stratum, now 4½ inches thick, of fine-grained brown material.

During the evening of June 8 the fall of ash was again resumed and continued until an unrecorded hour in the night, when it gradually diminished, entirely ceasing by the morning of the 9th, when daylight appeared. The ash which fell during this interval is the third stratum, composed of 1½ inches of very fine-grained, light-gray material.

Conditions as observed at Afognak by E. M. Ball differ in few essentials from those already described at Kodiak. The time of the appearance of the cloud is not recorded. It is, however, described as approaching in silence, there being no wind on the level of the ground and no thunder and lightning.

The ash reached the west end of Kenai Peninsula early in the morning of June 7, slight showers being reported at Port Graham at 3 a. m., and at Seldovia, 150 miles from Katmai volcano, at about the same time. Explosions and earthquakes had been noted since 9 a. m., June 6, becoming louder and more frequent throughout the day. The sky was overcast all day June 7, but there was no darkness, and comparatively small amounts of ash fell. The more heavily ash-laden clouds were at this time passing eastward, further south.

Boats on Cook Inlet reported lightning rising from the water in the direction of Barren Islands. Explosions and earthquakes were observed throughout the day. The next day there was a much heavier fall of ash, and there was modererate darkness for two hours during the forenoon. Frequent and violent earthquakes and explosions were noted. A dense cloud of dust came slowly in from the south about 3 a. m., June 9.

Ash fell from 5 a. m. till nearly noon, and inky darkness prevailed during part of this time. (This place is 150 miles from the Katmai volcano.) The fall of ash was much heavier than on the preceding day, about ¾ inch accumulating on the ground, and sulphur fumes accompanied its fall. Explosions were heard at irregular intervals on the 9th and continued in decreasing violence and frequency until the 14th. The last ash was recorded as falling on the 13th.

EXTENT OF THE CLOUD OF ASHES

The ash cloud reached the eastern end of Prince William Sound, 375 miles northeast of the volcano, about noon of June 7, at which time the log of the steamer *Bertha* records that the sun turned red in a clear sky, the air became hazy, and dust began falling. Cannonading at irregular intervals was heard aboard the steamer at 2 a. m., June 8, at Cordova. The Whiteshead wireless station reported at this time that the noises had already been heard there for 36 hours. There was a light westerly breeze when the dust first came, but after the steamer passed Cape Hinchenbrook the wind came from the east, but the fall of ash increased, continuing until the steamer reached Juneau, at 8 p. m., June 10. The heaviest fall was east of Cape St. Elias, in a fresh easterly breeze.

Dust fell at Katalla (410 miles from Katmai volcano) 48 hours after the first explosions, which sounded like discharges of dynamite in the near-by hills. The ash came first on a southwest, but afterward on an east, wind. For about three days the air was so thick that one could see only a mile or two. There was no darkness, and only about ¼ inch of ash fell. Vegetation was turned yellow.

The steamer *Admiral Sampson* also reported that ash fell all the way from Seldovia to Juneau. The air was so thick that one could not see more than 2 miles until passing Cape Spencer. Brass tarnished in 15 or 20 minutes after being polished.

It was reported in the press that dust fell in Ketchikan (900 miles from Katmai) June 8, and in Vancouver and Victoria June 11.

Dust fell 90 miles southwest of Eagle the morning of the 10th, and was reported from Dawson on the 11th. It fell also in small but appreciable quantities at Fairbanks, Ruby, and in the Innoko district.

SUBSEQUENT EVENTS

The freely erupting condition of the volcano, which appears to date from the cessation of the continuous violent explosions and of the ejection of large volumes of ashes, etc., about the 8th of June, continued until at least the last week in August. The exact conditions during this time are not known, but it is evident that violent earthquakes occurred frequently; that the crater or craters sent forth vast and probably continuous clouds of vapor, and that at times considerable dust was ejected.

At Cold Bay (50 miles from Katmai Volcano), where complete daily records were kept from June 6 to August 15, earthquakes were recorded on 50 of the 70 days from June 8 till August 15. They were heaviest on the following dates: June 8, 11, 13, 17, 21, 22, 28, July 4, 16, 21, 23, 24, 30, and 31. The most severe ones were noted on June 11, 21, and July 30.

Sounds, probably of volcanic explosions, were heard at Cold Bay on June 17, 22, 28, July 9, 16, and August 13.

The presence of fumes and falling dust at Cold Bay was influenced largely by the direction and intensity of the wind. Fumes were noted almost continually from June 8 till July 5, from July 12 till July 24, and on July 30 and 31, and August 10 to 12. They were strongest on June 8 to 11, 17, 23, 24, and August 5. A general decrease in their intensity is thus shown. Dust was prevalent in the air until June 24, falling in sufficient amount to be seen upon the ground on June 10, 13, 17, 21, and 24.

The times at which columns of steam and other visible evidence of conditions at the volcano could be seen from Cold Bay depended chiefly, if not wholly, upon weather conditions, and are consequently of little significance other than indicating that they were probably always present.

The glare of volcanic light upon the steam and clouds was observed on June 23 and July 21 and 31. This phenomenon could be seen only during favorable weather conditions, so its apparent absence at other times is not significant.

Some of the phenomena observed at Cold Bay were of widespread occurrence:

On the morning of June 9 observers at Naknek, 80 miles northwest of the volcano, saw a beautiful illuminated fun-

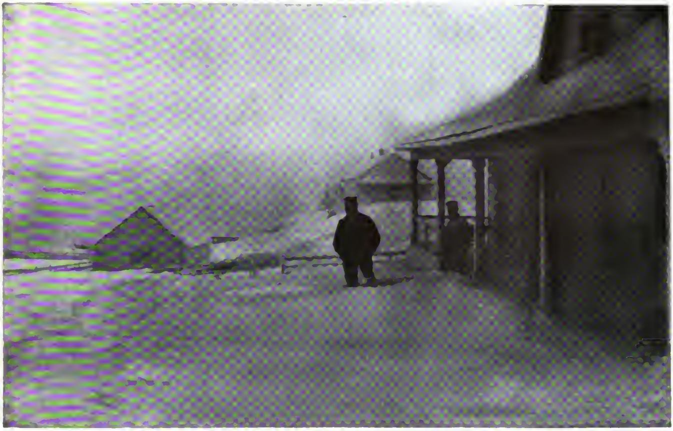


Photo by W. J. Erskine

THE END OF THE ASH FALL AT KODIAK

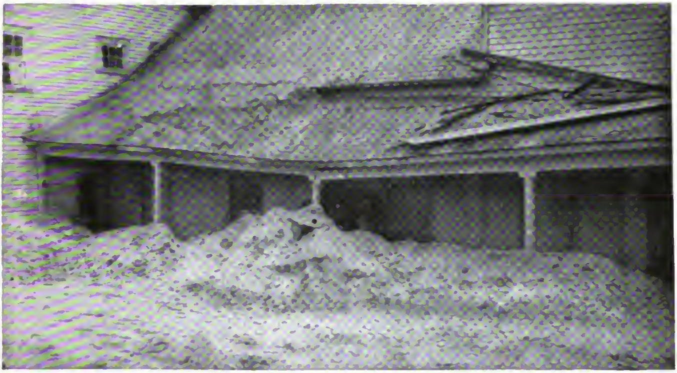


Photo by W. J. Erskine

A PORCH WHICH COLLAPSED BENEATH THE WEIGHT OF THE ASHES

Many of the houses at Kodiak were wrecked by the weight of ashes which descended in avalanches from the hillside. In other cases the roofs collapsed under the weight of ashes, for the deposits were frequently as much as 24 inches in thickness.

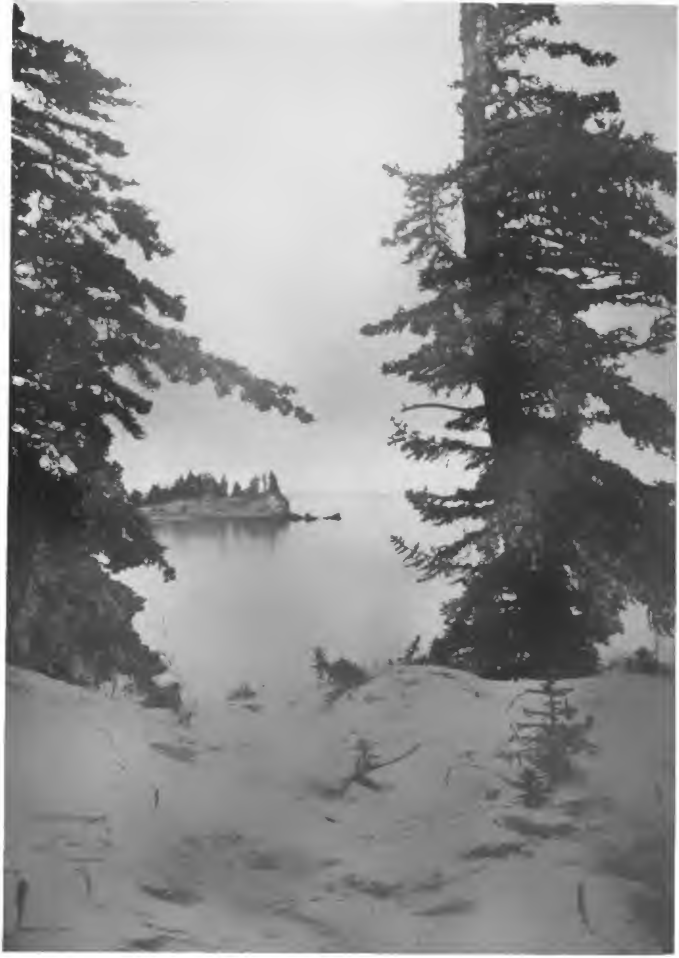


Photo by George C. Martin

SPRUCES NEAR KODIAK, WITH SOME ASH REMAINING ON THE BOUGHS, BUT NOT AS MUCH AS IN MORE SHELTERED PLACES: SEPTEMBER 4, 1912 nel-shaped cloud, which rose straight into the air to a considerable altitude, and, as there was no wind, retained its shape. It afterward assumed different colors and dissolved into cloud banks, being illuminated all the time. A similar cloud was observed from Iliamna, 115 miles north-northeast of the volcano and 135 miles from Naknek, at the same time, the description differing from the above only in the statement that in losing its funnel-shape form it assumed "the shape of a ship."

A severe earthquake was felt in the Yukon Valley and Alaska Range on July 6, the after effects continuing for about a week. It was apparently not felt in southwestern Alaska, and it is very doubtful whether it has any connection with the volcanic disturbance, as it was apparently central to the north of Mount McKinley.

Strong sulphurous fumes were reported by several on board the *Manning* from 6 to 9 a. m., July 27, when south of Marmot Island and about 120 miles east of the volcano. The author did not notice the fumes, but they were of sufficient strength to darken the new white-lead paint on the *Manning* and in Kodiak.

An immense column of steam ascending through the ordinary clouds in the position of Mount Katmai was seen by the writer during the evening of August 12 from Takli Island. While anchored here we heard almost continuous roar as of waterfalls or of surf on the islands, but no such surf was seen. Possibly the sound came from landslides in the ash, but more likely from the volcano.

THE RAIN THAT TARNISHED SILVER

On August 15 the writer was at the mouth of Katmai River. The wind was from the west and the sky was clear much of the day, except for cloud caps on the mountains.

The hills from west (magnetic) around through the north to the east (magnetic) of Katmai village were enveloped in a blue haze, which became denser throughout the morning. At noon the haze became so thick that the end of the ridge north of the Steamboat Bay Valley and the low hill 2 miles northwest of Katmai village were invisible from our anchorage, a mile above the mouth of the river.

Rain fell during the middle of the morning. The drops of water striking the eyes produced a sharp pain, and brass and silver were tarnished by the drops. The blue haze was thickest about noon and came nearer with the stronger wind, receding as the wind lightened. About 1 p. m. it became oppressively sultry, an apparent glare of heat being noted from the north. No sounds attributable to the volcanoes could be heard, nor were earthquakes felt. Photographs were taken, showing the edge of the haze on the end of the ridge west (magnetic) of our anchorage. No clouds over the volcanoes could be seen on account of the haze.

On August 16 sulphurous fumes were noted by H. M. Eakin at the Ophir Creek mines, 350 miles north of the volcano.

On August 17 earthquakes were felt at Naknek. They were so violent as to upset lamps on the table. Reports either of thunder or explosions were also heard.

COMPARISON WITH OTHER ERUPTIONS

The magnitude of a volcanic eruption is not properly measured by the loss of life and damage to property which it caused, for these are the accidental results of the eruption and are due largely to the chance proximity of cities. It is rather to be measured in terms of the natural phenomena; the quantity and distribution of the ejected material, the distance at which sound waves, dust, darkness, and fumes were observed, the violence of the accompanying earthquakes, the distribution and intensity of the resulting atmospheric conditions, and other natural phenomena of various kinds.

The greatest eruptions on record, measured by criteria of these kinds, include those of Krakatoa in 1883, Coseguina in 1835, Tomboro in 1815, Skaptar-Jökull in 1783, and Papandayang in 1772. The eruption of Katmai was apparently of a magnitude comparable with some of these (see article by Dr. Abbot in this number).

Comparing the eruption of Katmai with that of Krakatoa, in Sunda Strait between Java and Sumatra, in 1883, we

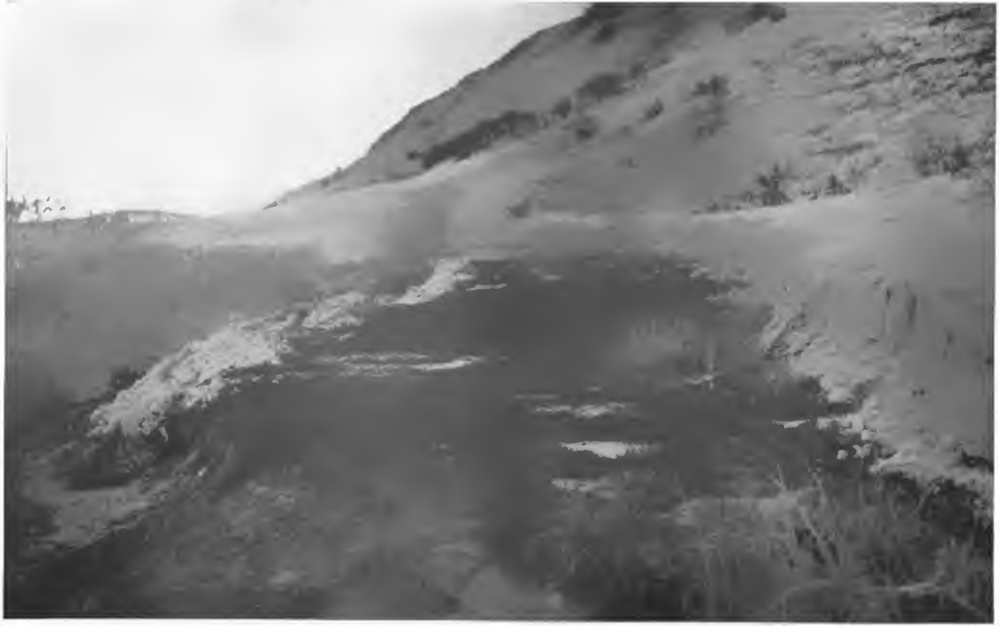


Photo by George C. Martin

GREAT ACCUMULATIONS OF ASH THAT HAD SLID DOWN THE STEEP HILLSIDES NEAR KODIAK, JULY 16, 1912

A small stream is fast removing this accumulation, having already exposed the grass in the foreground. Same gulch as shown on page 163

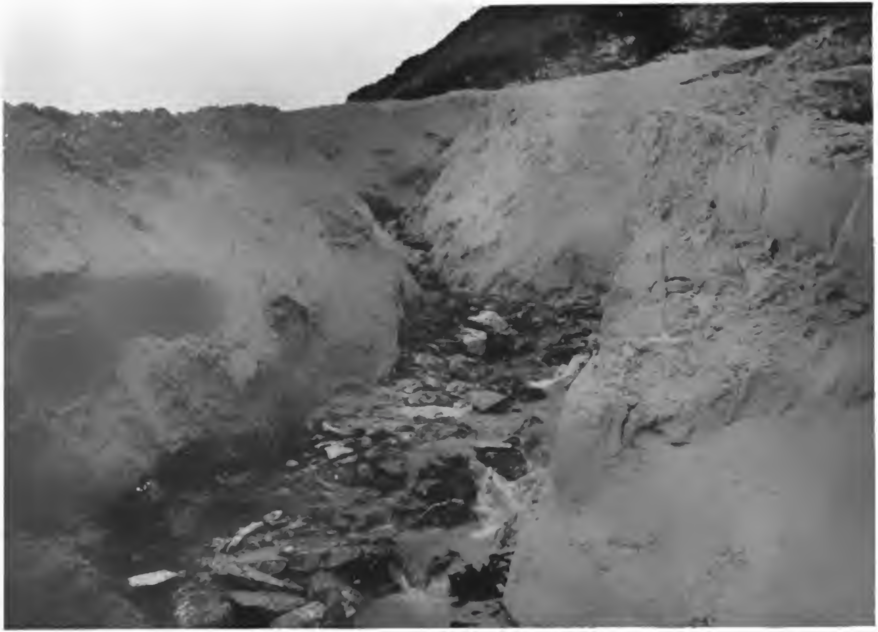


Photo by George C. Martin

These huge accumulations of ash, all of which had been carried from Katmai Volcano 100 miles away by the wind, give one some conception of the enormous amount of material which the volcano cast into the air in June, 1912. This is the same gulch as shown on page 162, but higher up.

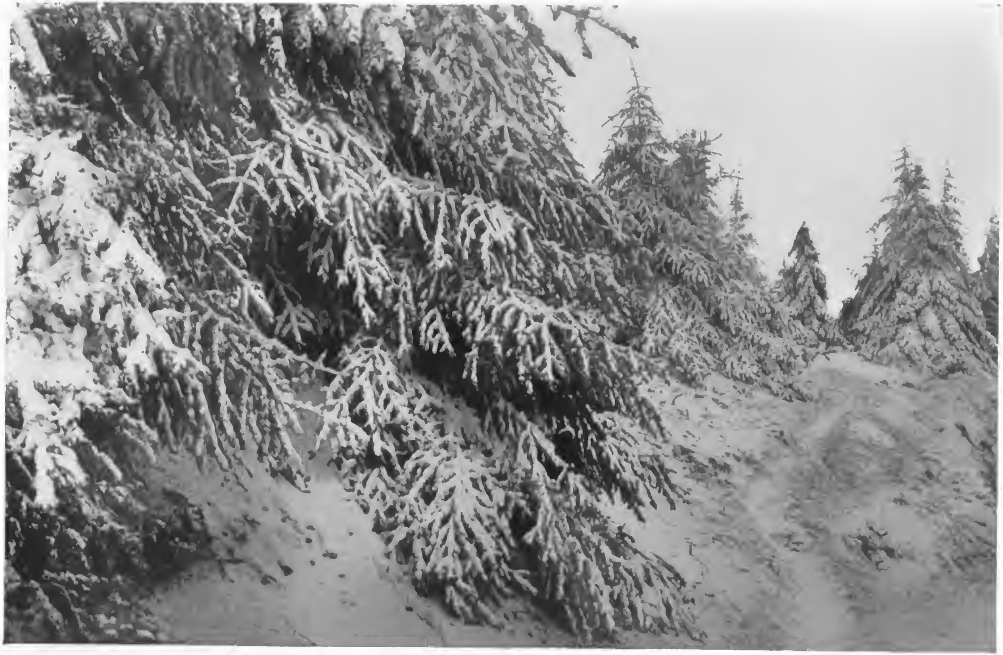


Photo by W. J. Erskine

ASH ON THE TREES NEAR KODIAK, JUNE 24, 1912

"The finer dust stuck to the trees, especially to the spruces, causing a wintry-looking scene which lasted all summer. This fine dust does not wash or shake off readily, and probably will cling to the more sheltered spruces for many years" (see page 178) find the volumes of ejected materials are not far from equal, but the explosive violence of the Krakatoa eruption was by far the greater. The explosions of Krakatoa were heard at a distance of 3,000 miles; those of Katmai were not recorded farther away than Juneau, a distance of 750 miles. But it should be noted that the country east of Juneau is chiefly an uninhabited wilderness, from which sounds are not likely to be reported, and that the more distant reports of sounds from Krakatoa came from islands and sailing vessels, both of which were more numerous in the Indian than in the North Pacific Ocean.

Darkness was recorded at a distance of 276 miles from Krakatoa and only at 150 miles from Katmai. The darkness lasted, however, only 22 hours at a distance of 133 miles and for 57 hours at a distance of 49 miles from Krakatoa, while there was darkness for practically 60 hours at a distance of 100 miles from Katmai.

The ash from Krakatoa fell to a depth of 18 inches in 24 hours at a distance of 66 miles, while the depth of the ash from Katmai was about 12 inches at a distance of 100 miles. (See also article by C. G. Abbot, page 191, in this number.)

The dust from Krakatoa fell at least 1,800, and possibly 3,300, miles away; that from Katmai has not been recorded authentically farther than Ketchikan, 900 miles away, but probably fell in small amounts at a distance of 1,200 or 1,500 miles. Here again it must be noted that the direction of heaviest ash fall from Katmai extended into the wilderness of British Columbia, where its maximum extent is difficult to recognize.

It is probably fair to conclude that the eruptions of Krakatoa and Katmai were of approximately equal magnitude, the former exceeding in the brief intensity of its culminating explosion, the latter in sustained violence, and the two being about equal in the quantity of material ejected (see also pages 166, 167).

THE GREATEST KNOWN ERUPTION

The eruption of Tomboro, on the island of Sumbawa, east of Java, in 1815, if the published reports are to be credited, appears to have exceeded all other known eruptions. It caused darkness lasting for three consecutive days at a distance of over 300 miles. Ash fell to a depth of 2 feet more than 850 miles away. Dust fell over an area of 1,000,000 square miles. The explosions were heard at a distance of 1,000 miles. The material ejected has been variously estimated at 28.6, and even at 50 cubic miles.

The eruption of Skaptar-Jökull, in Iceland, in 1783, appears to share with Tomboro the preëminence as the greatest eruption known. Comparison with the other eruptions here described is made difficult by the fact that the larger part of the material ejected was lava and not ash. The immense flows of lava from Skaptar-Jökull exceed in volume anything known during historic times. In addition to this, there were showers of ashes throughout the island, the atmosphere over Iceland was loaded with fine dust for months, crops were destroyed in Scotland, 600 miles away, and plants were blighted and sulphurous fumes were noted even in Holland, 1,100 or 1,200 miles away.

The eruption of Papandayang, in western Java, in 1772, was accompanied by the extrusion of much larger quantities of material than were thrown out by Krakatoa in 1883. Towns were buried under ejected materials at long distances from the mountain. The volcano was reduced in height from 9,000 feet to 5,000 feet.

The more famous eruptions of history, such as those of the Mediterranean, which are not mentioned above, occupy a prominent place in human, rather than in geologic, history. These volcanoes are famous because they are situated in thickly settled districts, and have consequently been familiar objects to millions of people, while their eruptions have caused great loss of life and property, not primarily because of their violence, but because of the proximity of the people and cities.

DESCRIPTION OF THE EJECTED MATERIAL

The character of the material ejected from Mount Katmai is as yet known

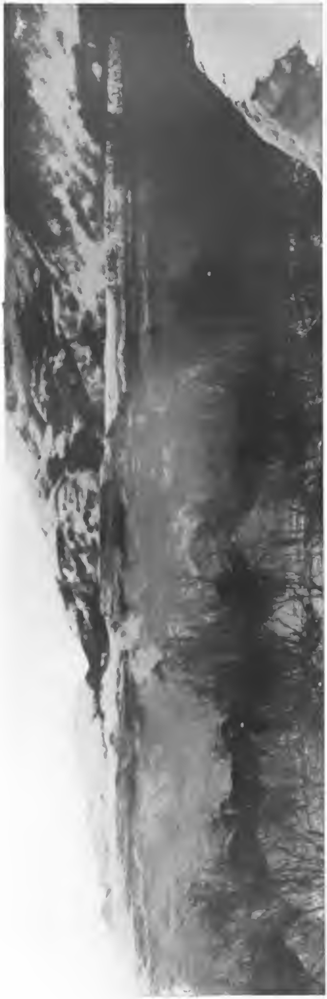


Photo by George C. Martin

ENORMOUS DRIFTS OF VOLCANIC ASHES AT AMALIK BAY, DEEPLY TRENCHED BY SUBSEQUENT EROSION: AUGUST 10, 1912

Note thickness of beds compared with height of men. This place is 15½ miles from Katmai Volcano

only from the deposits which fell at distances greater than 15 miles from the mountain. If streams of lava flowed out, they did not come within sight of the coast. The deposits which were studied in detail vary in thickness from 55 inches at the head of Amalik Bay, 15½ miles from the mountain, to 3½ inches at the east end of Afognak Island, 113 miles from the volcano.

Throughout this entire district, at least three layers corresponding to the three major outbreaks can be observed. The bottom layer is of relatively coarse gray material: the middle layer is finer and is brown, and the upper layer is the finest and is light gray or almost white. Each layer decreases in thickness with the distance from the volcano, the decrease being most marked in the bottom and middle layers (see pages 132 and 176).

The bottom layer consists of fragments of pumice mixed with a small proportion of fragments of crystals of feldspars and pyroxenes and other dark minerals. The pumice is consolidated lava-froth, mostly white, and varies in size from pieces 1 or 2 ounces in weight and 2 or 3 inches in longest dimension, which fell 15 miles from the volcano, to material of the grain of fine sand, which fell 70 to 100 miles away.

The middle or brown material near the base of the mountain consists of several layers, which differ from the lower bed in containing a smaller proportion of crystalline material and in containing a considerable amount of yellowish and brownish pumice. At distances of 70 to 80 miles from the mountain this material consists of two brown layers, the lower one of sandy grain and the upper of very fine dust. At distances of 90 to 100 miles from the mountain only a single layer could be recognized, and that was composed of impalpable brown dust.

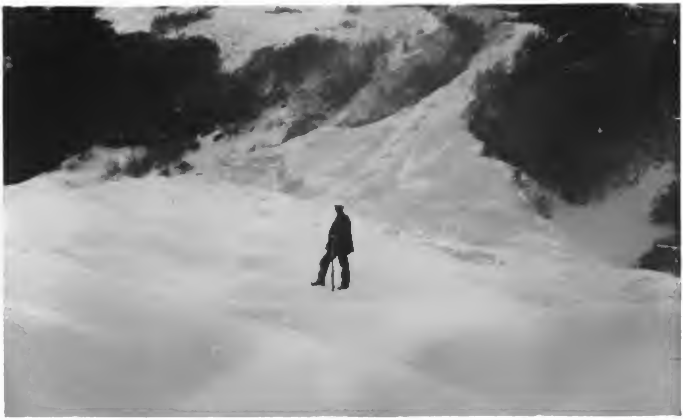


Photo by George C. Martin

SECONDARY ACCUMULATION OF PUMICE AT BASE OF MOUNTAIN WEST OF AMALIK BAY, AUGUST 10, 1912

The uppermost material consists of fine light gray or white material, varying less in grain with the distance from the mountain than the other layers. It consists of several alternating layers of fine sand and very fine dust near the mountain, and of a single layer of extremely fine white dust at a distance.

The finer material and the dust of all the layers are apparently composed chiefly of pulverized pumice of the same character as the larger pieces. This material in petrographic character is apparently rhyolitic.

The various layers aggregate about 4.9 cubic miles in bulk, extending over an area of many thousand square miles and ranging in thickness from 4½ feet 15 miles from the crater to almost one foot 100 miles away and to the fraction of an inch 150 miles away.

THE CHANGE IN THE LANDSCAPE

The effect of this covering on the landscape is well illustrated in the photographs (pages 166 and 168) taken on Takli Island, which lies in the mouth of Amalik Bay, about 21 miles southeast of the volcano, and was nearly in the direct track of the heaviest ash fall. This island is the place where those who risk the hazardous bidarka voyage across Shelikof Strait watch and wait for favorable weather. A small cove on the inner side of the island afforded shelter for our schooner during a northeast gale, which lasted several days, while the hills formed good lookout points from which the clouds pouring out from the volcano could be watched and studied at such fortunate moments as storm and fog permitted.

The island was covered with 3 feet of volcanic detritus, in which there were numerous fragments of pumice an inch long. The scene was a dreary one—a gray expanse of ashes broken only by a few ledges of ancient lava, patches of half-killed willow and stunted birch, and two small groves of young spruce. These spruce trees are of interest as being the westernmost evergreens on the Pacific coast of America. They are far from others of their kind, and I suspect that the Russians may have planted them there as they did at Unalaska.

The surface of the ash was strewn with recently killed willow and alder

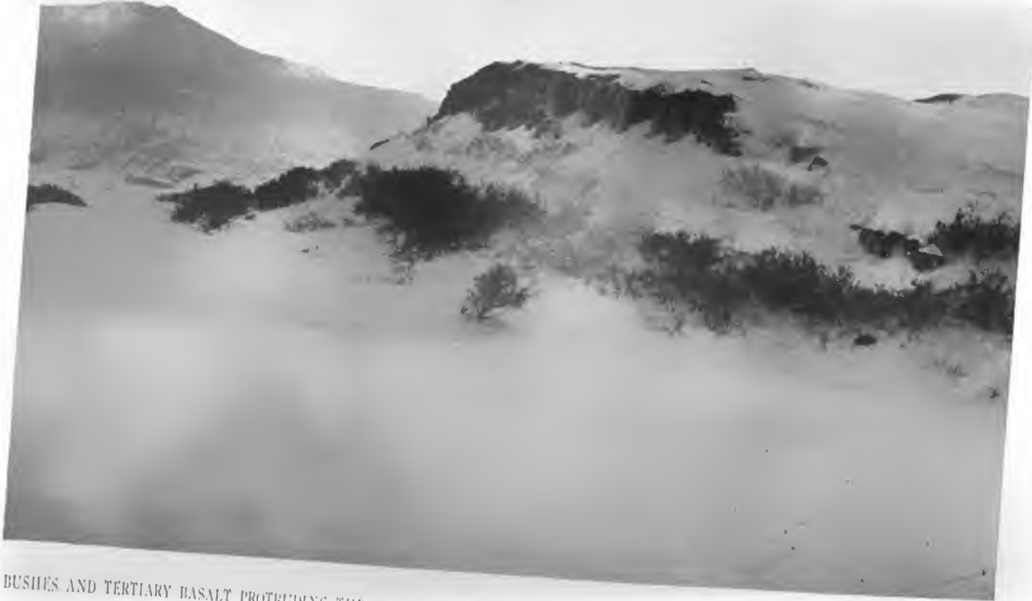


Photo by George C. Martin

BUSHES AND TERTIARY BASALT PROTRUDING THROUGH ASH ON TAKLI ISLAND, AUGUST 10, 1912: NOTE LEAVES ON SURFACE OF ASH

"The scene was a dreary one—a gray expanse of ashes broken only by a few ledges of ancient lava, patches of half-killed willow and stunted birch, and two small groves of young spruce" (see page 167)

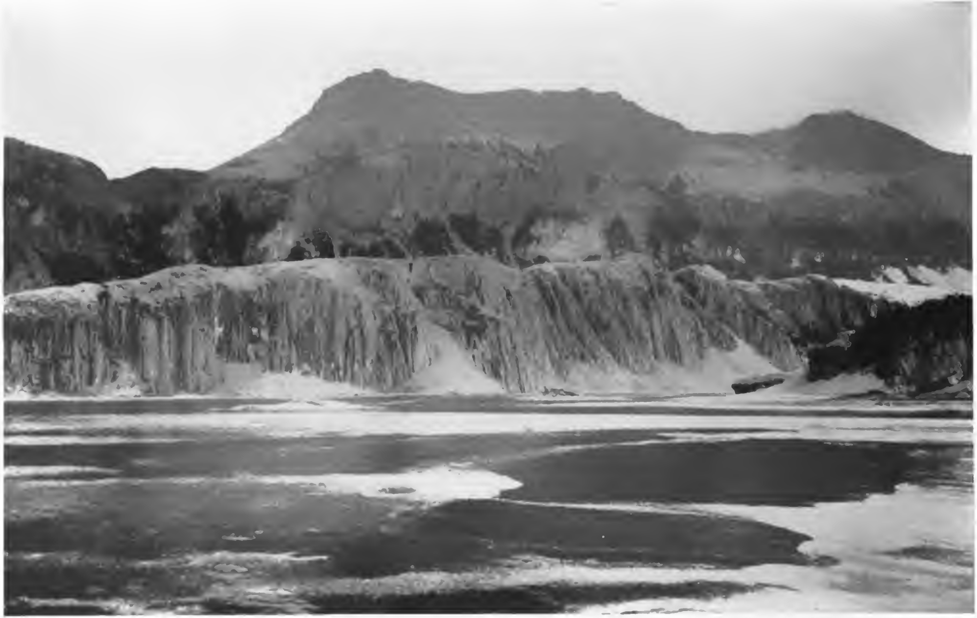


Photo by George C. Martin

CLIFFS OF COLUMNAR BASALT COVERED BY RECENT ASH NEAR HEAD OF WESTERN ARM OF AMALIK BAY, LOOKING EAST, AUGUST 10, 1912: NOTE THE PUMICE FLOATING IN THE WATER (SEE PAGES 178 AND 179) leaves, too fresh to have been killed at the eruption of June 6. They may have fallen, because the bushes were slowly dying through suffocation, or may have been withered by a more recent volcanic blast. Fumes were noticeable while we were there, in spite of the fact that the wind was prevailingly from the east.

I believe that a steady northwest wind at a time of only moderate activity would have carried sufficient fumes to make even vegetable life precarious. The only indications we saw of animal life in this locality were soaring eagles and tracks of foxes.

Amalik Bay heads back among the high mountains at a distance of about 15 miles from the volcano. We here realized that we were indeed in a volcanic land, for through the clouds of volcanic vapors which were pouring over the mountain crests and under the thick covering of the volcanic detritus of last June could be seen layer upon layer of columnar lava, aggregating at least 3,000 feet in thickness, which poured out from some mighty vents, probably in Miocene time, perhaps a million years ago. These ancient volcanic rocks, mantled by those of June, except on the cliffs too steep for the latter to lodge, are shown in all the views taken from this bay.

It was near the head of Amalik Bay that the thickest ash accumulation was found. Fifty-five inches on the level was measured at one point, this thickness representing the original fall and not a secondary accumulation. The material

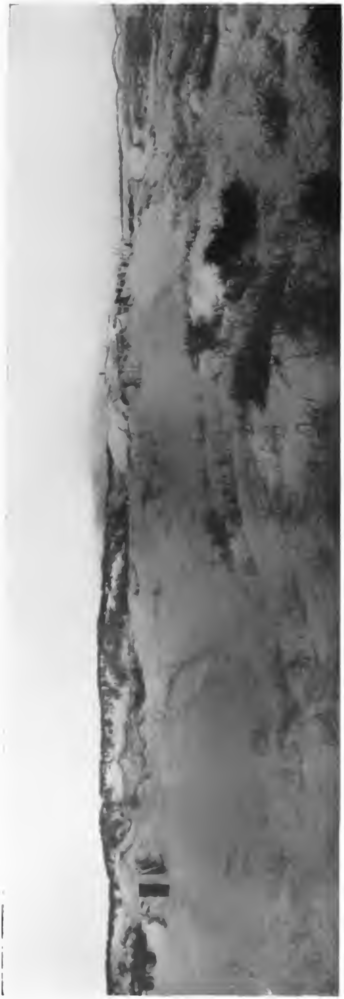


Photo by George C. Martin

DOUGLAS VILLAGE, SHOWING BARABARAS COATED WITH ASH, GRASS COMING THROUGH THE ASH, AND RUNS OF WET ASH ON THE STEEP SLOPES

The ash was thoroughly saturated from rains at the time the picture was taken, July 14, 1912

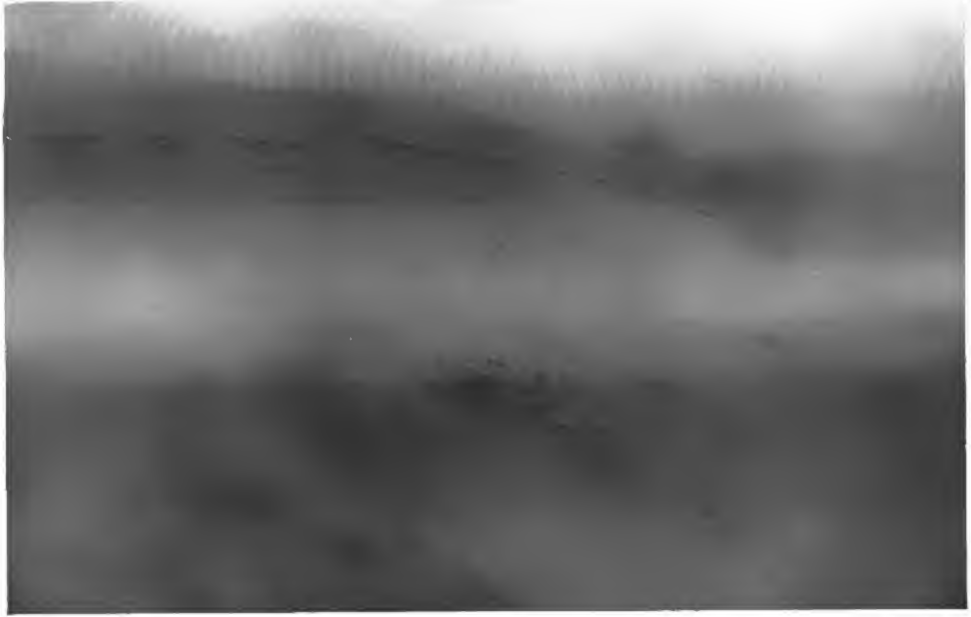


Photo by George C. Martin

WIND-BLOWN ASH NEAR KODIAK

"Hilltops and ridges are being swept bare, and thick drifts similar in form and surface to sand dunes are accumulating. At times of high wind the air is thick with drifting dust" (see page 174)

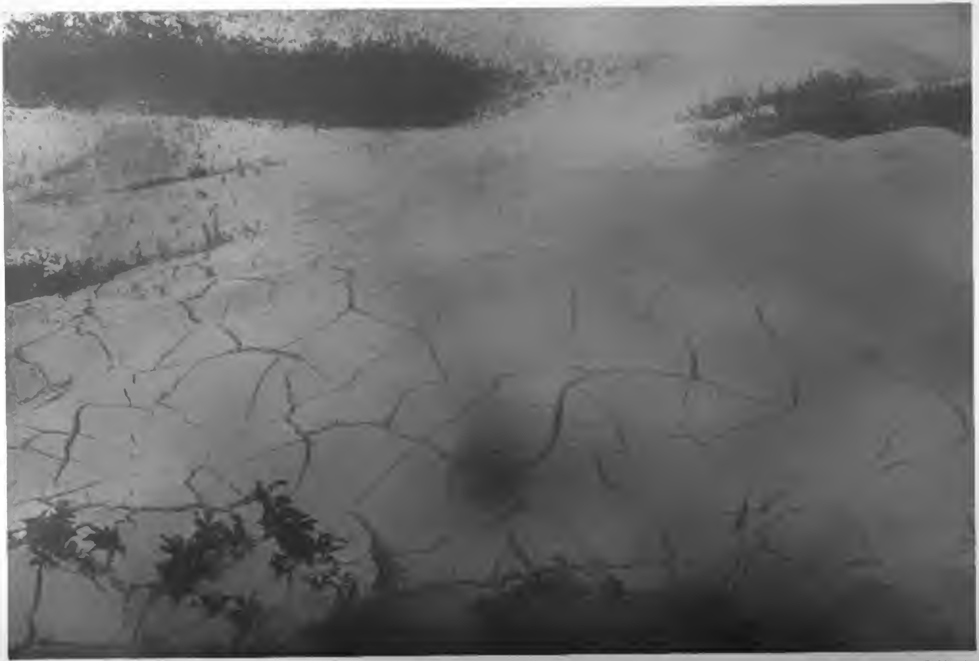


Photo by George C. Martin

CRACKS 2 INCHES WIDE AND 6 OR 8 INCHES DEEP IN ASH NEAR KODIAK, SEPTEMBER 3, 1912

The ash is 10 inches thick at this point The billowy surface is due to the shape of the ground

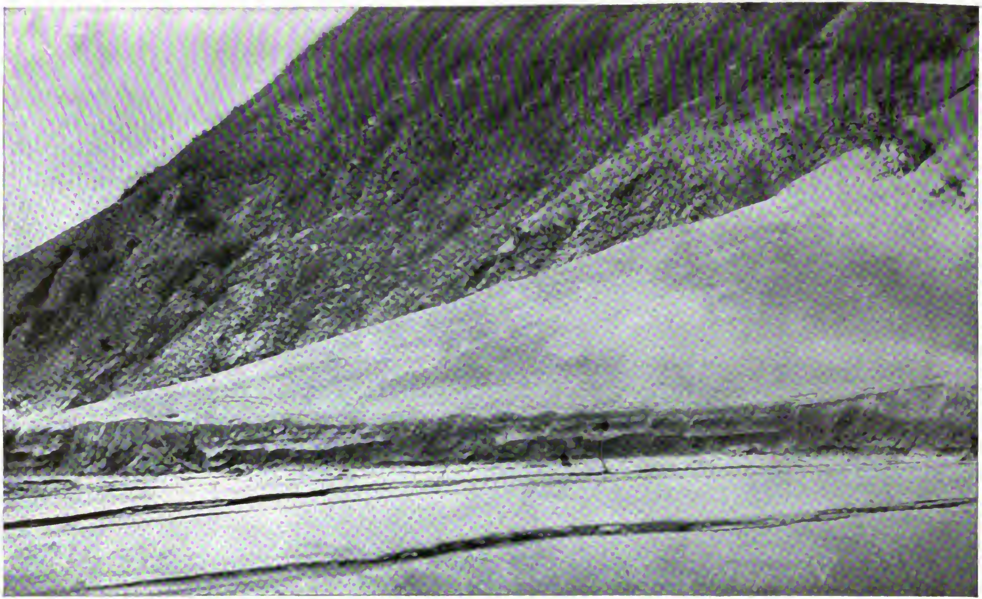
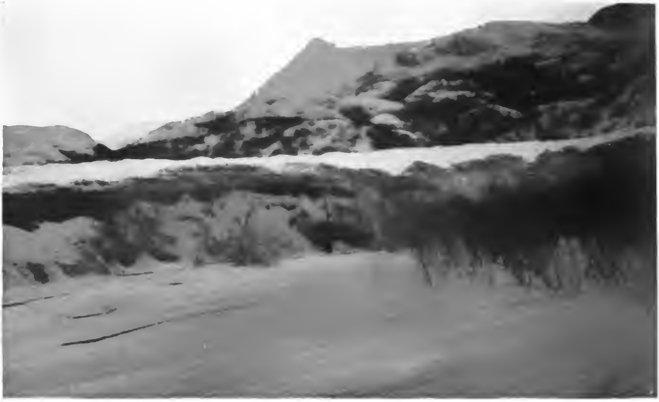


Photo by Lieut. J. F. Hahn, U. S. R. C. S.

ASH SLIDE FROM THE HILLS BACK OF KODIAK

"As soon as the material fell to such a thickness that it was not held down by the grass it began sliding down the steeper slopes. This action was accentuated by the rains, and large volumes descended the steep hillsides back of Kodiak, carrying houses off their foundations and crushing in the walls" (see page 175).



DRY CHANNEL OR GULCH ERODED IN ACCUMULATION OF VOLCANIC ASHES AT BASE OF MOUNTAIN WEST OF AMALIK, AUGUST 10, 1912

included one piece the size of a brick, which had traveled through the air for 15 miles.

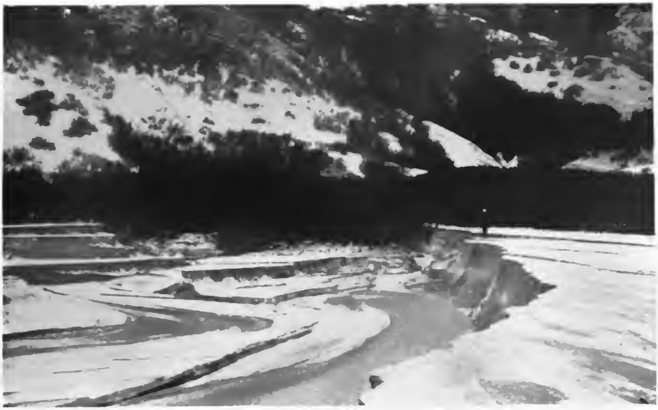
THREE DOGS ESCAPE DEATH

Katmai lies desolate on the edge of the great gray waste. It was fortunate that the people went away before the eruption, for a breath of hell swept down the valley, bringing death even to the trees. The only living things we saw were a few spears of grass, which had pushed up through the places where the wind had swept part of the ash away, and three dogs, who had escaped either by seeking refuge in the inner and deeper recesses of the barabaras or who possibly had been away on a hunt. The scene was the more deathly because it lay on the edge and in full view of the brilliantly green and undevastated country to the west (see page 146).

The appearance of this newly altered landscape is also shown in the views taken in the vicinity of Kodiak. The dust fell as a dry and impalpable powder, which was incapable of supporting weight. Heavy rains fell soon afterward, the greater part of the water being absorbed by the dust, which acquired the consistency of soft mush. It was in this condition at Douglas Village when we landed there. At every step one would sink to the ground, the feet sticking in the soft mud as in molten tar. When this water-soaked material dried, it cracked as mud does in drying. The cracks are in places 2 inches wide and extend through the two uppermost and finer layers (see page 172).

Hilltops and ridges are being swept bare, and thick drifts similar in form and surface to sand dunes are accumulating. At times of high wind the air is thick with the drifting dust. In the forested areas a large part of this dust is derived from the trees, the forests looking as if brush fires were running through them.

As soon as the material fell to such a thickness that it was not held down by the grass it began sliding down the steeper slopes. This action was accentuated by the rains, and large volumes descended the steep hillsides back of Kodiak carrying houses off their foundations and crushing in the walls. Such deposits are shown in many of the Kodiak views (see pages 134, 140, 173).



CREEK CUTTING A CHANNEL IN A DEEP ACCUMULATION OF VOLCANIC ASHES AT BASE OF MOUNTAIN WEST OF AMALIK BAY, AUGUST 10, 1912

"The streams are heavily overloaded with the volcanic detritus, and consequently are rapidly building up and extending their flood-plains, and are constructing large alluvial fans at their mouths and at points of flattening grade. Avalanches and deposition at the mouths of tributaries are changing the grades and even the courses of some of the streams. Lakes are being rapidly filled and great changes are being made in shore-lines."

DEPOSITS FORMED MORE THAN 25 FEET THICK

In the area of thicker ash-fall and on the steeper mountain slopes tremendous avalanches took place. The immense accumulations formed in this way are shown in the views from Katmai and from Amalik Bay. Much of this material had, on August 12, come to rest temporarily at least, but the enormous deposits gave evidence as to what the character of the avalanching must have been and inspired caution in climbing steep slopes.

The deposits along the stream below the waterfall, shown in view above, had been deeply trenched by the stream after it spread them. A thickness of over 25 feet was exposed and still the base of the deposits was not reached. This exposure is, moreover, not at the very foot of the hill, where the greatest thickness must have been deposited.

The streams are heavily overloaded with the volcanic detritus, and consequently are rapidly building up and extending their flood-plains, and are constructing large alluvial fans at their mouths and at points of flattening grade. Avalanches and deposition at the mouths of tributaries are changing the grades and even the courses of some of the streams. Lakes are being rapidly filled and great changes are being made in shore-lines.

MASSES OF PUMICE COVER THE SEA

The pumice is being washed into the sea by the combined action of streams, waves, and tides. There it forms great floating fields, which migrate with the winds and tides and greatly impede the navigation of small craft such as ours. An immense field of pumice which visited our anchorage at Takli Island is shown on page 178. The view shows the distance to which a dory could be forced into it. This visitor came and went under the influence of tidal currents and winds, and constituted a menace which led us to seek a more sheltered nook for our

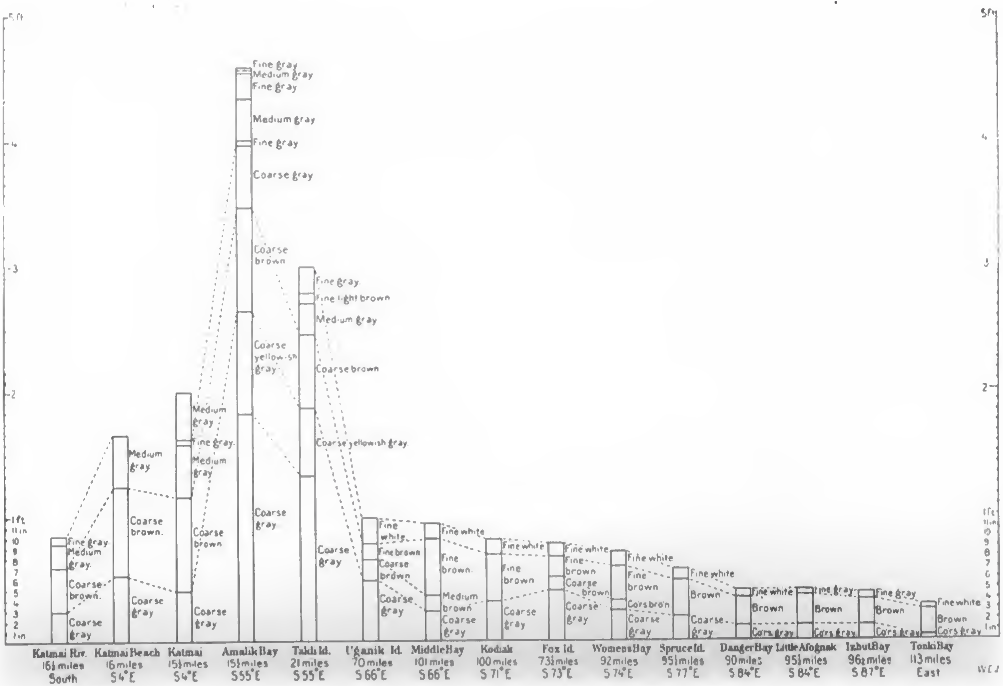


DIAGRAM SHOWING THICKNESSES OF ASH AND CORRELATION OF THE INDIVIDUAL LAYERS; THE DISTANCES AND DIRECTIONS ARE FROM THE VOLCANO (SEE PAGES 132 AND 166)

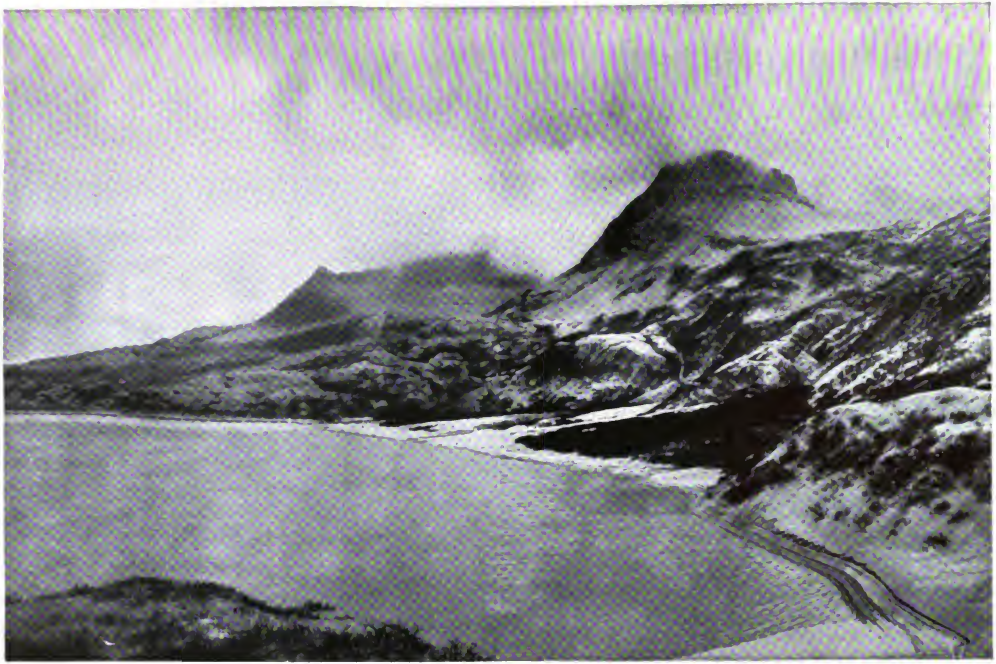


Photo by George C. Martin

LOOKING SOUTH FROM NEAR HEAD OF WESTERN ARM OF AMALIK BAY

Note the volcanic cloud pouring over the mountains and ash slides on hillside. Ash is 4 feet 7 inches thick on the level at this point, August 20, 1912

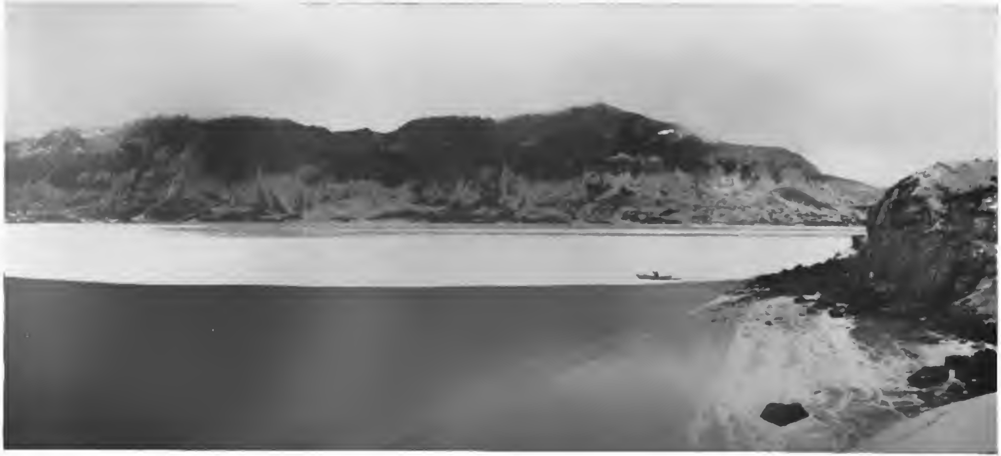


Photo by George C. Martin

A FIELD OF FLOATING PUMICE FROM KATMAI VOLCANO: AMALIK BAY FROM NORTH END OF TAKLI ISLAND

The white bands on the water are the floating pumice, while the dark area in the foreground is clear water. This is the immense field of pumice referred to on page 175. The boat has been forced as far into the field of pumice as its occupant can drive it. Note also the white streaks on the beach, which are also pumice, and the heavy ash slides on the mountain side.

Photo by John E. Thwaites

THE WAKE OF THE "DORA" THROUGH THE FLOATING PUMICE

Fishermen reported a field of pumice in Shelikof Strait dense enough to support a man. The pumice consists of rhyolitic glass, with a small amount of crystals of feldspars and pyroxenes. It is a lava which solidified at a time when it was giving off gases, and is consequently of a porous and spongy texture, which makes it so light that it will float.

boat. Even this was invaded by the floating rock, which jammed tight around and carried our boat with it when it moved, in spite of two anchors and two pieces of pig iron down, and forced us to make fast to a projecting cliff. The floating pumice was twelve inches thick alongside the boat and possibly was much thicker in the center of a large field. Fishermen reported a pumice field dense enough to support a man in Shelikof Strait.

The pumice, once in the sea, will drift around until it is thrown high upon some beach, is ground to powder, or finally becomes waterlogged and sinks.

EFFECT ON LIFE

The effect of the eruption on whatever vegetation clothed the flanks of the volcano was certainly annihilation. The position of the death-line around the mountain is not known, but it came practically down to the sea, 15 miles from the crater at Katmai. The conditions under which the bushes in Katmai Valley were killed is uncertain, but a hot blast like that of Pelée is suggested. The brush is living in Amalik Bay, no farther from the volcano, and where the fall of ash was twice as great as at Katmai.

The effect on the vegetation of Kodiak and Afognak islands was apparently only that of burial. Where the ash was washed off, even after many weeks, the grass soon came up, and apparently showed the effects of no other injury than that which would be caused by a similar burial under any other material. The stronger-stemmed plants, especially the fireweed, lupines, and some of the grasses, forced their way up through the cracks in the ash, and even through its solid mass where the thickness was not too great (see page 180).

The finer dust stuck to the trees, especially to the spruces, causing a wintry-looking scene which lasted all summer. This fine dust does not wash or shake off readily, and probably will cling to the more sheltered spruces for many years. The dust from the eruption of Redoubt in January, 1902, was still lodged on the spruces along Lake Clark in the summer of 1909. It apparently had a serious effect upon the trees, only the tops and the outer tips of the boughs showing a healthy growth. This same after effect

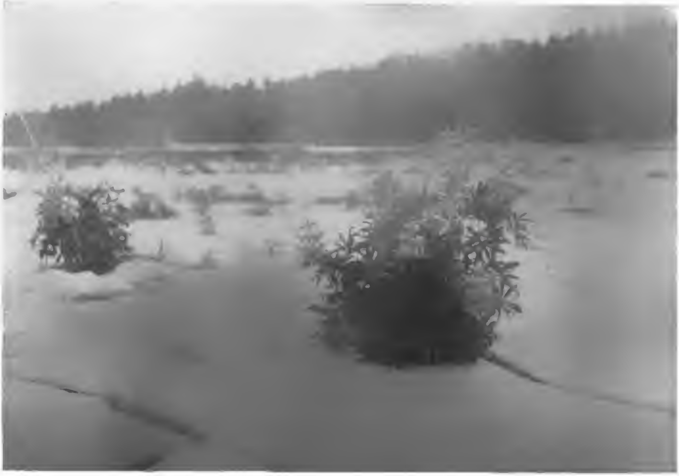


Photo by George C. Martin

LUPINES GROWING THROUGH CRACKS IN THE ASH NEAR KODIAK, SEPTEMBER 4, 1912

"The stronger-stemmed plants, especially the fireweed, lupines, and some of the grasses, forced their way up through the cracks in the ash, and even through its solid mass where the thickness was not too great" (see page 178).

is to be expected on Kodiak and Afognak islands and in lesser degree on the southern end of Kenai Peninsula.

The leaves of the currants, salmon berries, and many other of the shrubs and herbs on Kenai Peninsula and Prince William Sound were blighted by the dust or by the acid rain which fell there. This effect, curiously enough, did not occur in the district of thicker ash.

Marine life was affected to a larger degree than would perhaps be expected. The writer observed that the barnacles and mussels as far down as low tide in Katmai Bay were mostly dead. Kelp is apparently dead as far as the eastern end of Afognak Island. This is indeed a catastrophe, since the kelp is the one great aid to navigation on the Alaskan coast. Cod and halibut are reported to have died in great numbers in the shallower waters of lower Cook Inlet.

ANIMALS STRICKEN WITH BLINDNESS

The bears on Kodiak and Afognak islands were made bold by hunger, and attacked cattle in close proximity to the villages. It is reported that some of the bears were blind.

In the vicinity of Iliamna Lake, where not over 4 inches and for the most part less than 1 inch of ash fell, most of the small birds died, many rabbits were made blind, and the reindeer were seriously affected by the dust. Dead gulls, geese, ducks, ptarmigan, snipe, hawks, and many small birds were found at the mouth of Kakhonak River. A dead eagle was found hanging in a tree in such a position that he was probably killed by flying into the tree when blind. Blind rabbits, and birds which were either blind or had their eyes affected, were noted at several places in the Iliamna district. Small fish in some of the creeks were killed, and the fish in the lakes were driven offshore into deep water.

Small birds, squirrels, marmots, and mice were killed at Cold Bay. Mosquitoes were entirely exterminated throughout the greater part of the district in which the ash fell.

Man escaped the injuries received by the other animals by seeking shelter. Many of the people reported severe headaches, pains in the throat and lungs, and sore eyes while the dust and fumes were in the air. Two or three people in Kodiak died during the eruption, but their deaths are considered as being merely hastened by exposure and by breathing the dust and as not due primarily to the eruption.

Man was indirectly affected by the eruption through the injury to other animal life and to vegetation. The scarcity of salmon during the summer of 1912, the injury to crops and grass, and the destruction of game and fur animals must all be counted as indirect, but none the less serious, injuries to man. The effect on the salmon, through the probably complete filling of all the smaller lakes by the ash, which will for years work down the streams and hillsides into them, and through the possibly permanent destruction of the spawning grounds, is probably the most serious of these injuries.

Vegetation will be affected only temporarily, the soil will probably be improved, and the people can feel assured that not in many years, and possibly not in centuries, can the volcano accumulate enough force to cause another eruption of this character.

DO VOLCANIC EXPLOSIONS AFFECT OUR CLIMATE?

By C. G. Abbot

Director Astrophysical Observatory, Smithsonian Institution*

With Photographs by George C. Martin

IN THE month of June, 1912, I was engaged in making measurements at Bassour, Algeria, on the quantity of heat coming to the earth from the sun. At the same time my colleague, Mr. F. E. Fowle, was engaged in making similar measurements at Mount Wilson, in California. Recent work of the Astrophysical Observatory had strongly indicated that the sun is a variable star. The fluctuations in the amount of the solar radiation seemed to be of variable magnitudes, seldom exceeding 5 per cent, and occurring in irregular periods of from 5 to 10 days.

The work on which this conclusion was based had been done at Mount Wilson, in California, and it was not impossible that local atmospheric conditions may have had such an influence there that the observed changes might possibly be of atmospheric origin. To exclude this possibility it was necessary to show that the same results would be reached by simultaneous observations at another station so remote from Mount Wilson that the local circumstances would be entirely different.

Hence it was that an expedition occupied the station in Algeria in 1911, and again in 1912. As we shall not have occasion to refer again to the main purpose of the expedition, it will suffice to say here that, so far as yet reduced, high values of solar radiation obtained in Algeria coincide in time with high values obtained at Mount Wilson, and *vice versa;* so that the results seem to strongly confirm the supposed solar variation.

DUST FROM ALASKA OBSERVED IN ALGERIA

While observing on June 19, 1912, I noted streaks resembling smoke lying along the horizon, as if there were a forest fire in the neighborhood of the station. These appearances continued, and were soon joined by others more noticeable. After a day or two we began to see peculiar mottled figures like those of the mackerel sky, although absolutely no clouds were present. The phenomenon became so marked that we ceased entirely our observations of the

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* Published by permission of the Secretary of the Smithsonian Institution.

Photo by George C. Mart…

LUPINES GROWING THROUGH THE ASH NEAR KODIAK

solar radiation, as the sky seemed to be quite too poor for such work.

About the 25th of June a cloudy period began, with rain, and after this, of course, we expected that all these curious sky phenomena would have passed away; but not so, for when the clouds had quite passed by, about the 29th of June, we found that the whole sky was filled with haze, and this state of affairs continued even more pronounced until the expedition left Algeria, about September 10.

For a long time I supposed the haziness was local, but in August a letter from Mr. Fowle told me that at Mount Wilson also the same conditions prevailed, and the presumption was that they were world-wide. I then recalled reading in an American paper of the volcanic eruption at Mount Katmai, and turning to the paper, which fortunately had not been destroyed, I saw that the magnitude of the eruption must have been very great, and was perhaps the cause of the phenomena which we had observed.

On my return to America I found the matter even more certain, for Professor Kimball, of the Weather Bureau, reported a great increase of haziness at Mount Weather, Virginia, beginning on June 10. European journals also began to be filled with notices of an extraordinary haziness which had prevailed throughout the summer in Europe.

THE DUST TRAVELED 25 TO 40 MILES AN HOUR

Assuming these effects to have been due to the volcano in Alaska, it is interesting to note the rate at which the disturbances were propagated. Mr. Kimball noted the effect at Mount Weather, Virginia, 3,700 miles from Katmai, on June 10 and 11. The writer noted effects in Algeria on June 19, but the observations seemed to indicate that they were becoming appreciable as early as the morning of June 17. This was at a distance of 6,000 miles.* The first observations of Mr. Fowle were noted on June 21 at Mt. Wilson, distant 2,500 miles from Mount Katmai.

The rates of propagation then were roughly as follows: Toward Washington, 40 miles per hour; toward Bassour, 25 miles per hour; toward Mount Wilson, 3 miles per hour. The great delay in reaching Mount Wilson was doubtless because the prevailing winds in the higher atmosphere have a course from westerly

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* By shortest course directly over the North Pole. It is probable that the actual course was much longer.

Photo by George C. Martin

BLUEBELLS AND MOSS AMONG THE ASHES: MIDDLE BAY, SEPTEMBER 12, 1912

toward easterly, so that Mount Wilson lay decidedly too far to the south for the most favorable communication.

HOW THE SUN'S HEAT IS MEASURED

Before taking up the question of the reasonableness of the hypothesis that the dust from Mount Katmai was distributed all over the higher atmosphere and remained there for months in suspension, we may consider for a moment the exact effects which were observed with our apparatus and the nature of the apparatus with which these effects were observed.

In the first place we have the pyrheliometer, an instrument for measuring the heating effect of the sun at the earth's surface. In the second place we have the spectro-bolometer, that wonderful device of Langley for observing the excessively minute heating effects of the rays of the solar spectrum. Imagine that you have before you a very intense solar spectrum, and that it is still early morning, with the sun perhaps an hour and a half high.

If you had a thin, delicate blackened thermometer, you could carry it along in the spectrum from the extreme ultra-violet to far beyond the red, and detect varying degrees of temperature rise, proportional to the heat produced by each spectral ray. It would make no difference whether these lay between the violet and the red and were visible to the eye, or were the short wave-length photographic rays beyond the visible end of the violet spectrum, or the long wave-length rays lying beyond the visible end of the red. All would produce their just and proportional heating effects upon this delicate thermometer. At each of the Fraunhofer absorption lines the thermometer would fall slightly.

The "A" band of oxygen would produce a comparatively great decrease of temperature, and beyond the red there would be still more prominently the great bands, due to the water vapor in the earth's atmosphere.

Suppose now that several hours later you repeated the experiment. You would find that, excepting in these great water-vapor bands, practically every part of the spectrum was hotter than before, and that the change had been greatest in the violet end. Knowing the altitude of the sun above the horizon at each time of observation, you could compute the thickness of the layer of air traversed by the solar beam.

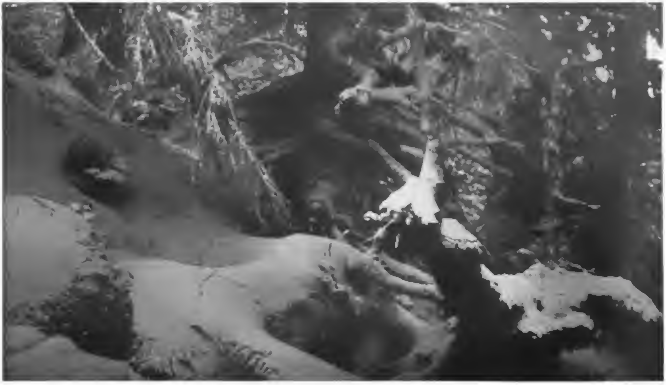

Photo by George C. Martin

ASH IN FOREST NEAR HEAD OF WOMAN'S BAY, NEAR UZINKI, AUGUST 1, 1912

From this it would be possible to determine how much the intensity of the rays would have been increased had the observation been made outside of the atmosphere altogether—as if it could have been made, for instance, upon the moon. From this result one could determine how much the rays of each part of the spectrum were diminished in intensity by their passage through the atmosphere on their way to the surface of the earth.

AN INSTRUMENT THAT MEASURES ONE-MILLIONTH PART OF A DEGREE OF HEAT

No ordinary thermometer would be of any value for this purpose; but the bolometer invented by Langley about 1881 is an electrical thermometer so sensitive that a change of temperature of 1 one-millionth part of a degree is observable with it under ordinary conditions.

We were equipped with such an apparatus at Bassour, and Mr. Fowle had one similar on Mount Wilson, and with these, following the scheme of operations which I have indicated above, we measured for all rays of the solar spectrum the transparency of the atmosphere. Similar measurements have been made at Mount Wilson for many years, and were made in Algeria in the year 1911. The following table shows the decrease in the transparency of the atmosphere, first for the beam of the sun as a whole, and then for the rays of different regions of the solar spectrum:

Percentage Decrease of Direct Solar Radiation by Haze of 1912

Computed for Solar Zenith Distance 48°

Station.	Bassour.			
Radiation.	Total.	Ultra-violet.	Green.	Infra-red.
Wave-length	All.	3.700	5,300	10,000
July 1 to 31	18.0	21.4	22.2	16.8
August 1 to 31	19.3	19.7	24.3	14.9
September 5	16.4	14.3	18.3	14.9

Station.	Mount Wilson.			
Radiation.	Total.	Ultra-violet.	Green.	Infra-red.
Wave-length	All.	3.700	5,300	10,000
July 1 to 31	10.7	15.5	12.9	5.4
August 1 to 31	16.8	27.5	23.1	14.0
September 5	17.1	....	....	....

20 PER CENT OF SUN'S HEAT LOST IN 1912

From these results we see that the uncommon haziness of the sky during the summer of 1912 produced a very marked decrease in the direct solar radiation in all parts of the spectrum,* and reached nearly 20 per cent at high sun for the total heat.

There was, however, some compensation in the increased brightness of the sky for this apparently very great loss in 1912. In order to understand this, think for a moment what happens to the sun-rays before they reach the earth's surface. *If we could go outside the earth's atmosphere—to the moon, for instance—the sky would look dark as it does at night, studded with stars, except when we looked directly toward the brilliant sun, which would shine wholly undimmed.* It is the earth's atmosphere which changes all this, for in the passage of a sunbeam through it, even on a cloudless day, two kinds of losses occur—one imperceptible to the eye, the other giving us the skylight.

Firstly, some of the invisible rays of the infra-red spectrum are totally absorbed by the water vapor, oxygen, and carbon-dioxide of the earth's atmosphere, and cease to exist as radiation long before the sunbeam reaches the earth's surface. Secondly, the molecules of the air and the fine dust suspended in it scatter and diffusely reflect the sun-rays, and make the sky bright, much as the motes of dust in a sun-lit room reveal the path of the sunbeam in it.

Thus, of the sun-rays scattered in the earth's atmosphere, some reach the observer at the earth's surface, coming no longer from the sun directly, but diffusely reflected from every part of the sky. The remainder are scattered away into space and lost altogether for the purpose of heating and lighting the earth.

HEAT REFLECTED INTO SPACE INSTEAD OF REACHING THE EARTH'S ATMOSPHERE

It is this last-mentioned portion which most interests us here, for we wish to inquire how much more heat than is usual was lost to the earth by reflection of the atmosphere to space in 1912, owing to the dust which came from Katmai volcano. One can easily see that since the light of the sky and the loss by reflection to space both depend on the presence of the molecules and the dust of the atmosphere, an increase of the dust (at least up to a certain point) must make the sky brighter and the loss to space greater also.

What, then, do we ordinarily receive from the sun?

(A) The direct solar beam.

(B) The skylight.

What else would we have received if there were no atmosphere?

(C) The rays absorbed by atmospheric vapors.

(D) The rays reflected away to space from the upper atmosphere.

The sum of these four quantities should be approximately equal to the heat of the solar beam outside the earth's atmosphere, as, for instance, on the moon. This we may call (E). As we cannot measure (D) directly, we must find it by subtracting A+B+C from E. It is of course (D), the loss to space, with which we are principally concerned.

For we must ask ourselves: *Was the earth's loss of heat by reflection of the upper air to space made greater by reason of the haze of 1912?* To answer this we must know the value of the expression $(D)=\{E-(A+B+C)\}$ as it was in 1912 and as it is ordinarily.

Measurements of (A), the direct sun-rays and (C), the water vapor and other absorption, we make every day, and I devised and built with my own hands at Bassour two pieces of apparatus for measuring (B), the light of the sky. From observations taken a little before noon on September 5, 6, and 7, 1912, we found at Bassour the following results, stated in calories per sq. cm. per minute:

(A) Heating effect of the direct beam of zenith sun	1.250
(B) Heating effect of the entire sky	0.245
(C) Heating effect of the rays absorbed by water vapor from sun and sky radiation	0.175
Total (A + B + C)	1.670
(E) Heating effect of total radiation outside the earth's atmosphere (from the moon, for instance)	1.950
$(D)=(E)-[(A)+(B)+(C)]$	0.280

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* This circumstance must have caused a decided increase in the exposures required by photographers for solio prints.

The difference between the heat outside the earth's atmosphere and the sum of the various parts of it indicated above is 0.280 calory per sq. cm. per minute, and this we may suppose represents approximately the loss of heat by reflection from the atmosphere to space in the summer of 1912.

In former years similar experiments to these have been made at Mount Wilson and Mount Whitney, and it was found in each case that the sum of the radiation: (A) of the direct solar beam. (B) from the sky, and (C) lost by the absorption in the atmosphere, lacked less than 0.05 calory of the total heating effect outside the atmosphere.

I am of the opinion that the difference between these results of 1912 at Bassour and those of earlier years at Mount Wilson and Mount Whitney (or about 0.20 calory) represents approximately the radiation reflected away to space by the volcanic dust of 1912, or, in other words, the loss of heat available to warm the earth, which we must attribute to the great haziness which prevailed in 1912. The difference is about 10 per cent of the whole intensity of the sun's radiation outside the atmosphere. *Hence I conclude that the dust of Katmai diminished the heat available to warm the earth in the north temperate zone by about ten per cent during the summer of 1912.*

In accordance with the laws of heat and radiation, this might produce a fall of 7° centigrade in the temperature of the earth as a whole, if it was effective for a long enough period of time. provided that there were no counteracting influences, such as altered cloudiness or decreased nocturnal earth radiation, brought about at the same time with, and perhaps by reason of, the increased haziness of the atmosphere.*

WORLD-WIDE HAZE CAUSED BY TERRIFIC ERUPTIONS IN JAPAN AND ICELAND

Having now given estimates of some effects of the great haziness of 1912, we shall next consider whether volcanoes can really produce such world-wide haze. To answer this we have only to go back to the records of times of the greatest volcanic actions of the last 150 years.*

In the year 1783 occurred the eruption of Asamayama, Japan, stated to be the most frightful eruption on record. Immense rocks were hurled in all directions and towns and villages buried. *One stone, said to be 264 × 120 feet, fell into a river, and looked like an island.*

In the same year occurred the (if possible) still more extraordinary eruption of Skaptar Jökull, in Iceland, beginning near the end of May and producing the most violent eruptions on June 8 and 18. Arago records that the dry "fog of 1783 commenced about the same day (June 18) at places distant from each other, such as Paris and Avignon, Turin and Padua. It extended from the north coast of Africa to Sweden and lasted more than a month.

The lower air did not seem to be its vehicle, for in some parts the fog came on with a south, in others with a north, wind. Abundant rains and the strongest winds did not dissipate it. In Languedoc its density was such that the sun was not visible in the morning up to 17° altitude above the horizon. The rest of the day the sun was red, and could be observed with the unprotected eye. At the time of new moon the nights were so bright that the light was compared to that of full moon, even at midnight."

In 1814 occurred the great eruption of the volcano of Mayon, in the Philippine Islands, and on April 7 to 12, 1815, the

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* The results here given on the combined brightness of the sun and the sky must as yet be regarded only as provisional. No experiments were made at Bassour on the brightness of the sky prior to the coming on of the haze; hence we shall be obliged to wait until the haze has entirely cleared before we can have measurements strictly representative of the conditions which would prevail there in a clear sky. Dr. Dorno, observing at Davos, in Switzerland, does not confirm my conclusion that the total brightness of sun and sky was decreased by the presence of the haze, although he found very strong effects of the haziness in reducing the intensity of direct sun rays, and noted even that the combined brightness of sun and sky in the green had fallen off by 7 per cent as compared with that of the combined brightness in the red. His measurements of the combined brightness do not extend to the whole spectrum, so that it is possible that in this fact may lie the explanation of the divergence between his results and mine.

* See Report of Krakatoa Committee of Royal Society of Great Britain.

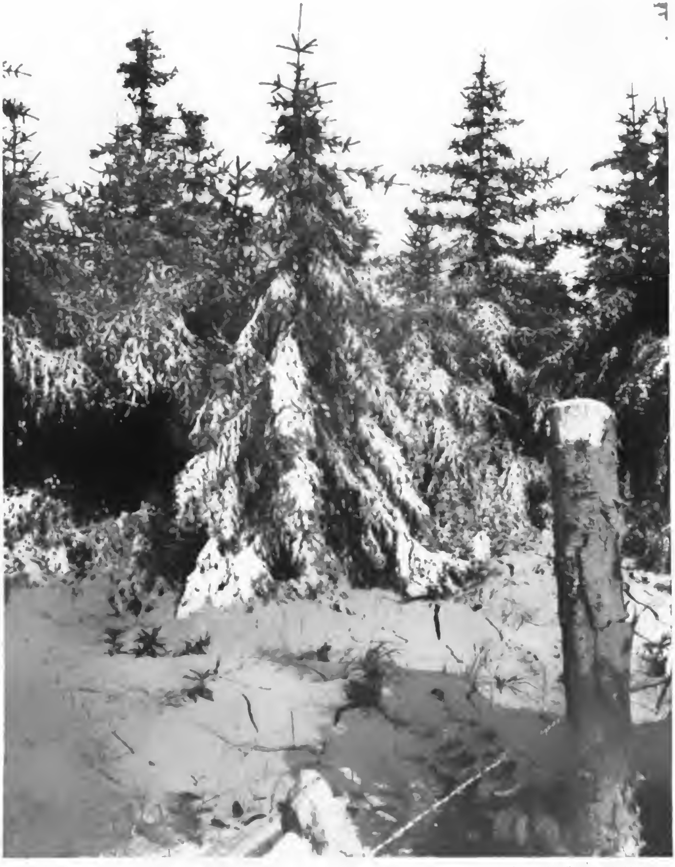

Photo by George C. Martin

ASH-LADEN TREES NEAR KODIAK, AUGUST 26, 1912
(See article by George C. Martin, page 179)

Photo by George C. Martin

POLEMONIUM IN BLOOM AT BASE OF ASH-COVERED CLIFF NEAR KODIAK, SEPTEMBER 4, 1912

extraordinary eruption of Tomboro, Sumbawa, of which it is said "this eruption was the greatest since that of Skaptar Jökull, in 1783." *For three days there was darkness for a distance of 300 miles.* After these extraordinary eruptions there were noted in Europe streaky skies, haziness, long twilights, and red sunsets; so that "the year 1815 is the most remarkable as regards sunset lights recorded up to that date."

THE DRY FOG OF 1831 AND 1883

Passing on to the year 1831, there occurred three moderate eruptions and three more of the very first magnitude. Graham's Island was thrown up, and eruptions took place in the Babujan Islands and at Pichincha.

Arago says: "The extraordinary dry fog of 1831 was observed in the four quarters of the world. It was remarked on the coast of Africa on August 3, at Odessa on August 9, in the south of France and at Paris on August 10, in the United States on August 15. The light of the sun was so much diminished that it was possible to observe its disk all day with the unprotected eye. On the coast of Africa the sun became visible only after passing an altitude of 15° or 20°. M. Rozet, in Algeria, and others in Annapolis, United States, and in the south of France saw the solar disk of an azure greenish or emerald color. The sky was never dark at night, and at midnight, even, in August, small print could be read in Siberia, at Berlin, Genoa, etc. On August 3, at Berlin, the sun must have been 19° below the horizon when small print was legible at midnight."

Passing over, among many others, for lack of space, the great eruptions of Hecla in 1845 and 1846, and those of Vesuvius and Merapi in 1872, we come to the tremendous explosion of Krakatoa of August 27, 1883, and the eruption of St. Augustine, in Alaska, October 6, 1883. The extraordinary atmospheric phenomena which closely followed these remarkable volcanic eruptions were so evidently in the relation of effects to causes that there can be no doubt as to the reasonableness of ascribing the haze of the past summer to the volcanic eruption in Alaska, provided that eruption was comparable in magnitude to those of which we have spoken.

KATMAI DEPOSITS ONE FOOT OF ASHES 100 MILES AWAY

The eruption of Mount Katmai volcano reached its most vigorous phase on June 6 and 7, 1912. Observations were made by Captain Perry, of the revenue cutter *Manning*, at Kodiak Island, situated 100 miles from the volcano. At 5 o'clock, June 6, a noise like distant thunder was heard and ashes began to fall. Thunder and lightning were frequent, and the sky became dark, although two hours before sunset.

When the deposit of ashes ceased, at 9 a. m. of June 7, about 5 inches of ashes had fallen. At noon they commenced to fall again, and increased in density, until at 1 o'clock it was impossible to see beyond a distance of 50 feet. *At 2 o'clock pitch darkness had set in, and although all ashes of the previous day had been removed from the ship, yet the decks, masts, and yards were again heavily laden, and the men worked incessantly with shovels and streams of water to clear the decks, falling over one another in the blackness.*

At 2.30 p. m. of June 8 the fall of ashes decreased, the sky assumed a reddish color, objects became dimly visible, and the deposition ceased by the morning of June 9. At Kodiak Island, 100 miles from the volcano, the ashes reached the average depth of one foot. (See article by George C. Martin in this number.)

THE VOLCANIC EXPLOSION OF KRAKATOA WAS HEARD 3,000 MILES AWAY

In order to compare the intensity of this volcanic outbreak with the great outburst at Krakatoa in 1883, which stands at the high-water mark of volcanic activity for the past century, it will be interesting to review some of the phenomena of the Krakatoa eruption as stated in the report of the Krakatoa Committee of the Royal Society of Great Britain.

May 20, 1883, booming sounds were heard at Batavia and Buitenzorg, towns in Java, situated about 100 miles from Krakatoa, and on May 21 a sprinkling of ashes was noticed on both sides of the Strait of Sunda. From this time until August 26 the eruption of Krakatoa continued with considerable intensity, although several times parties landed on the island.

On August 26, 27, and 28, violent explosions occurred, which *blew away the whole northern and lower portion of the island of Krakatoa, leaving submarine cavities sometimes a thousand feet deep where before the island had risen to 1,400 feet above sea-level.* The water wave following the greatest explosion of August 27 was estimated to be 50 feet deep or more when it reached the coasts of Java and Sumatra. *A ship of war was carried inland for nearly 2 miles, and left 30 feet above sea-level.* Between 30,000 and 40,000 people lost their lives by the overwhelming of their villages.

The explosion was heard as far as the island of Rodriguez, nearly 3,000 miles away, and *the area over which the actual noise of the explosion was heard embraced one-thirteenth of the area of the globe.* The air waves traveled outward from the volcano as a center till they reached the antipodes in South America, were then reflected backward to their origin, and from there returned, so that they were observed by the meteorological stations to have made four complete passages away from Krakatoa and three in return before their traces were lost.

The sea waves were several feet high after crossing the Indian Ocean, and at a distance of several thousand miles, and were even thought to be observed by the tide gauges of the English Channel. The height of the column projected from the volcano on August 26 was measured as 17 miles (89,760 feet).

Beginning shortly after the eruption, the sky at distant regions of the earth became hazy, and abnormally long twilights and sunset glows continued to be observed even as much as two years after the occurrence. It was computed that the fine dust from the volcano reached an altitude at first of 120,000 feet and was still at a height of 50,000 feet more than a year after the eruption.

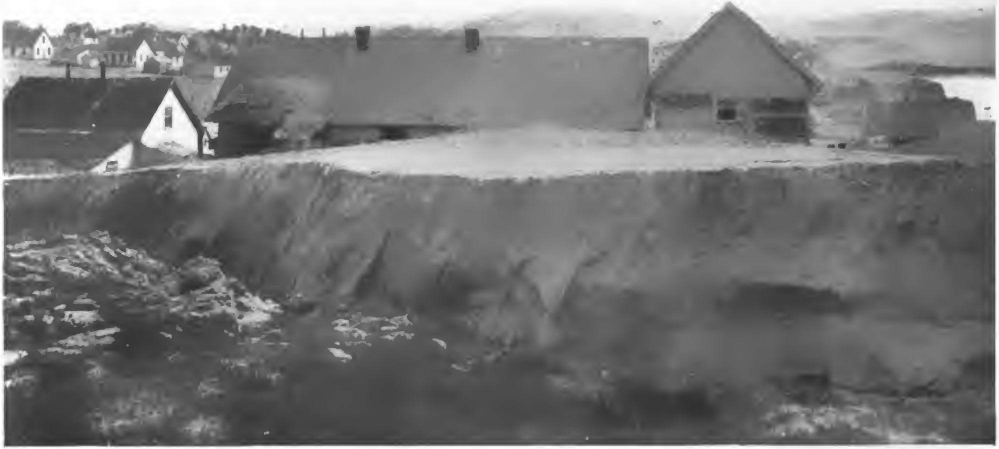

Photo by George C. Martin

THE REMAINS OF AN AVALANCHE OF VOLCANIC ASH WHICH WRECKED MANY OF THE HOUSES IN THE TOWN OF KODIAK

BUT KRAKATOA DID NOT EJECT AS MUCH ASHES AS KATMAI

Although the violence and destructiveness of this celebrated eruption places it in the first rank, and the quantity of matter ejected was very great, yet when we compare the depth of ashes falling at considerable distances from the Island of Krakatoa with the quantity of ashes which fell on Kodiak Island after the eruption of Mount Katmai it appears that the volcano of Krakatoa was far inferior in this respect to the recent one.

According to the investigations of Verbeek, the average depth of the ashes at the distance of 100 miles from the volcano of Krakatoa was about one quarter of an inch. We have seen that at Kodiak Island the depth of the deposit from Katmai was about one foot and the average depth at a distance of 100 miles from Katmai at least one inch (see page 132). If, then, the air was filled with haze from Krakatoa for two years after the eruption, it need not surprise us that a great amount of haze occurred following the eruption of Katmai.

But it must not be forgotten that the violence of the eruption of Krakatoa was most extraordinary. It is possible that although the amount of ashes sent out from Mount Katmai may have greatly exceeded the quantity sent out from Krakatoa, yet the height to which the ashes were projected in the atmosphere by Krakatoa may have greatly exceeded the height to which they were projected from Katmai. Thus perhaps we ought not to infer that the meteorological consequences of Katmai should last as long as those extraordinary ones which were observed after Krakatoa. Recent pyrheliometer measurements, however, show that in January, 1913, the sky was still abnormally hazy.

It is only since just before the Krakatoa eruption that we have had measurements of the intensity of solar radiation comparable to those which were available in 1912. From a paper of Prof. H. H. Kimball* I copy the accompanying illustration, which shows the fluctuation of the annual solar radiation received at the earth's surface as measured at different stations.†

VIOLENT VOLCANIC OUTBURSTS SERIOUSLY DIMINISH THE AMOUNT OF HEAT WE RECEIVE FROM THE SUN.

It is apparent that very great departures from the usual intensities occurred from 1883 to 1887, 1888 to 1893, and from 1902 to 1904 respectively. Having now convinced ourselves that such departures may reasonably be expected in consequence of great volcanic eruptions, it is interesting to find, if we can, the causes of the diminished solar radiation at about 1891 and 1903 respectively.

The activity of the Island of Vulcano lasted 20 months—from August 3, 1888, to March 22, 1890. The most violent explosions occurred on August 4, 1888; December 26, 1889, and March 15, 1890. An eruption which took place there on January 6, 1889, was observed by A. Ricco from the Observatory of Palermo to be sending a column of smoke to the height of more than 6 miles.

An eruption of Mayon, in the Philippine Islands, took place December 15, 1888. Vast columns of ashes ascended from the crater, and in a short time the darkness was so intense that, though it was midday, lights had to be used in Manila. Violent eruptions were also reported in the same year in other islands of the Philippine group.

A vessel passing the Island of Oshima, in Japan, reported violent eruptions of the volcano of Miharaizan on April 13, 1889. On January 16, 1890, a violent eruption took place at Mount Zoo, near the town of Fukuyama, in Japan.

In February, 1890, there was the volcanic eruption at the Island of Bogoslof, in Bering Sea. Three small new islands were created in the immediate vicinity and the island was raised 1,000 feet. Ashes were collected in Unalaska, about 40 miles distant.

BANDAI-SAN THROWS UP 700 MILLION TONS OF MATERIAL

On June 7, 1892, a severe eruption

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* Bulletin of the Mount Weather Observatory, vol. 3, Part II.

† Professor Kimball's data comprise the four broken lines near curve A of the figure, page 196. I have marked them 1-1 (from 1883 to 1900); 2-2 (from 1896 to 1903); 3-3 (from 1901 to 1905); 4-4 (from 1906 to 1909). The results of different observers have been combined and smoothed, as will be stated below. Results of this kind from single stations are much influenced by local haziness. In future years much fuller information will be available.

began from a volcano near the capital of the Island of the Great Sangir. Some thousands of people were killed and immense quantities of ashes fell all over the island. The noise of this eruption was heard at Sandakan, 500 miles away.

An eruption of Mount Etna began on the nights of July 8 and 9, 1892, and continued with more or less intensity all the month. Occasional less severe outbreaks occurred afterwards. The eruption was notable for the enormous quantities of smoke and sand emitted.

But undoubtedly the greatest eruption of this period occurred in northern Japan. Bandai-San is a mountain about 5,800 feet high, which had shown no sign of activity for about 1,100 years. A subordinate peak, called "Little Bandai-San," arose on its northeastern side. On the morning of July 15, 1888, "Little Bandai-San" was blown completely into the air and obliterated. The debris buried and devastated an area of at least 30 square miles. An estimate based on the depth of the debris in this area indicated that the quantity of earth, rocks, and volcanic material reached 700 million tons, and that doubtless the true figure would be much greater. About 600 people perished horribly and many more were reduced to destitution.

It was, with one possible exception, the most terrible volcanic disaster which had occurred in Japan since the famous explosion of Asamayama in 1783. The force of an explosion capable of tearing a mountain to bits and distributing it over an area of 30 square miles may well have been sufficient to blow the column of ashes high enough into the air to have been carried over the earth like those ejected from the crater of Krakatoa in 1883.

THE DEVASTATION WROUGHT BY MONT PELÉE

The town of St. Pierre, on the Island of Martinique, was struck and totally destroyed by two volcanic blasts of nearly equal severity, occurring respectively on May 8 and May 20, 1902. The loss of life reached nearly 30,000 persons. The volcano of Mont Pelée continued in activity for a long time after these occasions. An eruption of May 28, observed by Mr. George Kennan, carried ejected matter up to a height estimated by Mr. Kennan as exceeding 12,000 feet.

It seems doubtful, however, whether the eruption of Mont Pelée and the nearly simultaneous one of Soufrière, on St. Vincent Island, produced a widely distributed haze in the atmosphere.

On the one hand the measurements made at the Astrophysical Observatory of the Smithsonian Institution on the transmission of the earth's atmosphere in 1901, 1902, and 1903 show that during the latter part of 1902 and the whole of 1903 the transparency of the atmosphere was very decidedly low—below the normal. On the other hand, however, a measurement of the total intensity of the solar radiation, made at this observatory in Washington on October 15, 1902, gives a value of the intensity of 1.40 calories per sq. cm. per minute, which is among the very highest observations of this kind which have been made at this station.

It is of course possible, though rather unlikely, that the haze due to the eruption of Mont Pelée was not so quickly distributed toward the more northern latitudes as that of Mount Katmai, in Alaska, in 1912, was diffused toward more southerly ones; so that perhaps the dust from Mont Pelée reached Washington later than October 15, 1902,

THE WHOLE SIDE OF THE MOUNTAIN BLOWN AWAY

On October 24, 1902, however, there occurred the eruption of Santa Maria, in Guatemala. The ashes from this volcano covered an area of more than 125,000 square miles. Pumice stone and ashes fell to a depth of 8 inches or more in a region extending over about 2,500 square miles, within which the houses and farm buildings were crushed under the weight of the ejected material and in some cases totally destroyed. Six thousand persons are believed to have been killed.

The cloud from the volcano reached 18 miles in height, and the sound of the explosion was heard at Costa Rica, 500 miles away. *The whole side of the mountain was blown away, exposing a cliff, nearly perpendicular, 7,000 feet in height and forming a crater three-quarters of a mile wide, seven-eighths of a mile long, and 1,500 feet deep.*

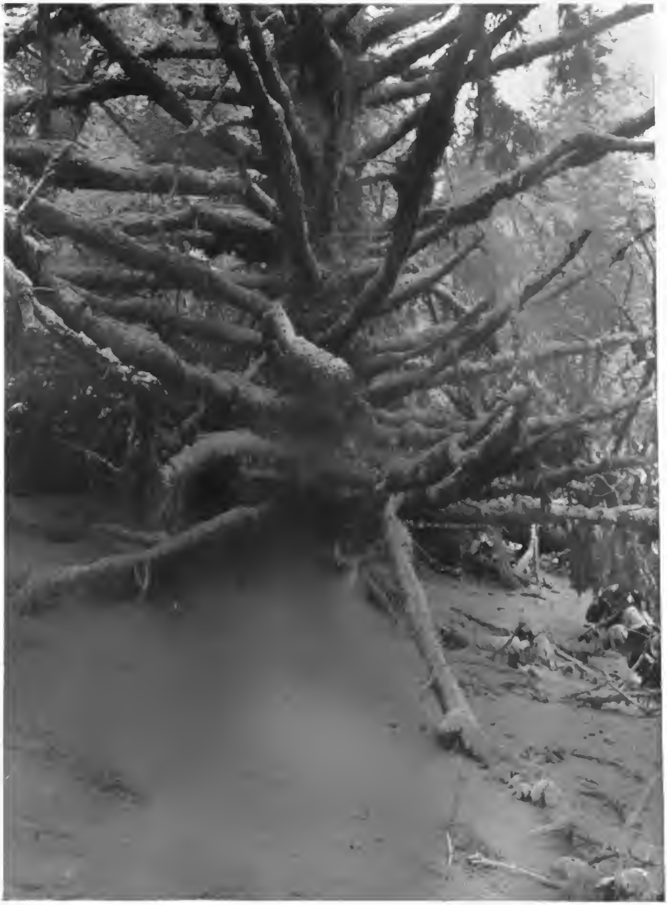

Photo by George C. Martin

OLD FOREST SPRUCE, WITH MOSS-COVERED TRUNK AND BRANCHES LOADED WITH ASH, NEAR KODIAK, SEPTEMBER 4, 1912

(See article by George C. Martin, pages 179-180)

Photo by George C. Martin

[illegible]

The magnificent volcano of Colima, in Mexico (height, 3,960 meters, or 13,000 feet), had a period of great activity from February 15 to March 24, 1903, during which there were maximum eruptions on 12 days. In a photograph taken March 7, 1903, the column of ashes seems to reach a height of about 17 miles.

It is clear, I think, from these records that the decrease of solar radiation from 1888 to 1893 had much volcanic action to cause it, including Bandai San, Mayon, in the Philippines, Vulcano Island, and others; and that the depression, whose maximum was in 1903, was attributable to the terrific explosion of Santa Maria, in Guatemala, on October 24, 1902, reinforced by the later eruptions of Colima, in Mexico, of which a photograph is given on page 198.

DOES THE VOLCANIC HAZE PRODUCE COLD?

I have made some preliminary study to determine if the haziness produced by volcanoes causes a decreased temperature at the earth's surface.

Taking the year 1912, I find from the international ten-day mean values published by the German Marine Observatory that the high altitude stations of southwestern Europe, namely, Pic du Midi, Puy de Dôme, Brocken, Schneekoppe, Säntis, and Hoch-Obir, give a very marked indication of a decrease in temperature with respect to the normal beginning about the middle of July. The six stations I have named are very consistent with one another in this indication, and the following table, giving their mean result, shows the effect very clearly:

Temperature Departures (Centigrade), Mean of Six Mountain Stations, 1912.

Month	February.			March.			April.			May.			June.			July.		
Decade.........	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	Mean.
Departures...	+0.7	+3.6	+5.9	+2.1	+0.7	+2.8	−1.0	−3.2	−0.9	+0.5	+2.8	−1.5	−0.6	−0.6	+0.6	−1.7	+2.1	+0°.69

Month.........	July.			August.			September.			October.			November.					
Decade.........	...	...	3	1	2	3	1	2	3	1	2	3	1	2	3	...	...	Mean.
Departures...	...	...	−0.8	−2.2	−3.6	−2.1	−5.0	4.4	−4.9	−2.6	−0.4	−0.3	−3.4	−3.6	−1.5	...	...	2°.68

Stations in our own country, however, are not so consistent. I have chosen some where the cloudiness is small so as to avoid that complication. The stations chosen are arranged in the following table with regard to whether their temperature departures* are increasingly negative after July, and thus support the indication of the high mountain stations of southwestern Europe, or not. It is interesting to see that Leadville and Flagstaff, which are both very high stations, fall in the first category.

Station.	Jan.	Feb.	Mar.	April.	May.	June	July.	Aug.	Sept.	Oct	Nov.	Mean.	
												1.	2.
El Paso..	+1.6	−2.5	−1.9	−4.7	−0.6	−1.8	+0.5	−0.8	−1.7	0.2	−1.6	−1.65	−0.76
Pueblo...	−3.0	+0.5	−7.2	−1.7	+0.1	−4.0	1.4	−0.1	−7.0	−0.9	+2.2	−2.55	−1.14
Dodge...	−9.3	+0.9	−11.1	−1.6	+2.3	−5.0	−0.9	0.0	−4.2	−1.6	+4.5	−3.93	+0.56
Santa Fe	+0.4	−1.8	−1.8	−5.3	1.3	−3.8	−0.5	+0.2	−2.5	−1.0	+1.0	−1.93	−0.56
Leadville	+0.5	−2.0	−0.6	−4.1	−0.5	−2.7	−2.2	−1.8	−7.2	1.8	+0.2	−1.57	−2.56
Flagstaff.	+1.6	+1.8	−1.7	−4.0	−1.9	−0.9	−3.8	−1.6	3.2	0.9	+2.3	−0.85	−1.44
Tucson ..	+0.7	−1.6	−2.9	−6.8	−2.4	+1.1	−5.1	−2.7	−3.6	−3.8	−0.9	−1.98	−3.22

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*These departures are in Fahrenheit degrees

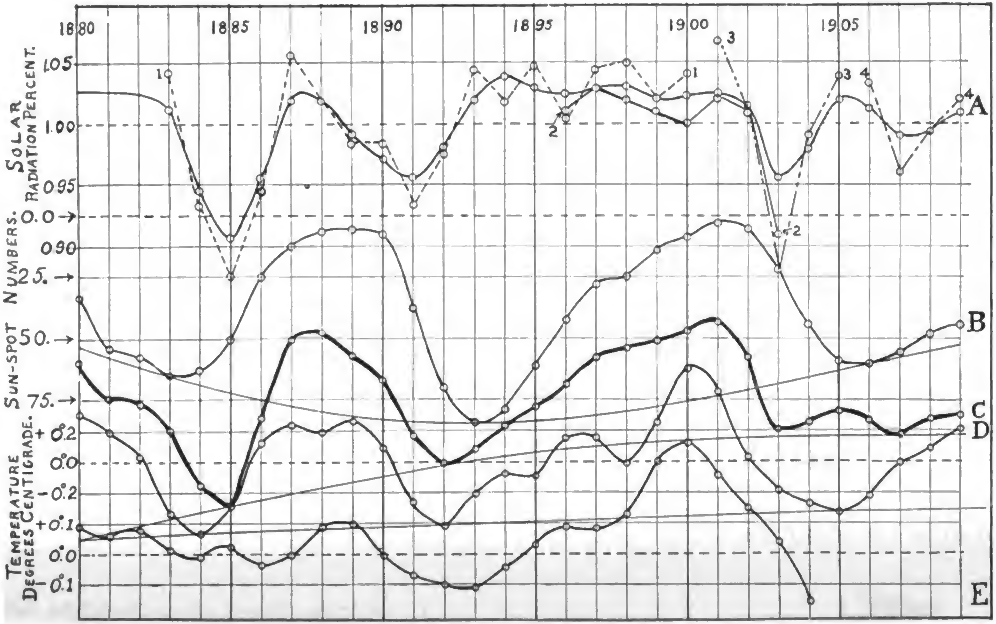

DIAGRAM TO SHOW VARIATIONS IN SOLAR RADIATION AND IN THE EARTH'S TEMPERARURE: 1880–1910

The periods of low solar radiation and low temperature coincide with periods when there was much volcanic dust in the air (see pages 101, 105, 107)

The volcanic effect, if here present, is certainly obscured by other influences.

As stated above, there seems to be a strong indication that the mountain stations were rendered appreciably cooler by the explosion of June, 1912. In order to see if a similar effect was caused by the dust cloud emanating from Krakatoa in 1883, I have studied the temperature departures for Pic du Midi, Puy de Dôme, and Schneekoppe for the years 1882 to 1884, inclusive, but there does not appear to have been at that time any such decrease of temperature following the eruption of Krakatoa, August 27, 1883, as occurred in July, 1912. Nevertheless at Pic du Midi there was a very well marked decrease in the daily temperature range, beginning with September, 1883. I have found for some other stations a similar decrease of the daily temperature range following the eruption of Krakatoa.

The fact is that the temperature of the earth is a function of so many variable quantities that general or cosmical effects are often greatly obscured by local ones. Studies have, however, been made by various authors to detect if there is a periodicity of terrestrial temperature corresponding in time to the sun-spot cycle of about 11 years, and it has been found by Koppen, Arctowski, Nordmann, Newcomb, Abbot and Fowle, and others that there is indeed an increased temperature at the time of minimum sun-spots. This increase of temperature is greater than would be caused directly by the darkening of the sun by sun-spots, so that it is supposed that there is accompanying the spots some secondary influence affecting terrestrial temperatures.

The fluctuations of temperature are, however, not fully accounted for by the march of the sun-spots, and I have endeavored to see whether a combination of the well-known effect of the sun-spot cycle with the effect of the volcanic haze will produce a more exact correspondence between the cosmical phenomena and the temperature of the earth.

Referring to page 196, the curve (A) is a smoothed representation of the average intensity of the direct solar radiation. The method of smoothing the curve is as follows, taking for example the year 1895: Add to the value for 1894 twice that for 1905 and that for 1896 and divide by 4. Curve (B) is the smoothed sun-spot curve as given by Wolfer. The sun-spot numbers run from 0 to about 80. Curve (C) is a combination of (A) and (B). They are taken in the following proportions: Multiply the percentage departure of radiation by 6* and subtract from it the sun-spot number for the given year. Curve (D) represents the departures of mean maximum temperature for 15 stations of the United States distributed all over the country. It is smoothed in the same manner as curve (A). Curve (E) represents the departures of temperature for the whole world, also smoothed in the same manner as curves (A) and (D). The data for the curves (D) and (E) are taken from Annals, Astrophysical Observatory, volume 2, page 192, and from the Monthly Weather Review of the United States Weather Bureau.

Although there is a considerable degree of correspondence between curve (B) and curve (D), yet it is not hard to see that there is also much of discordance.

For example, the sun-spot maximum of 1893 was greater than that of 1883 or 1906, yet the temperature curve (D) indicates a gradual increase of temperature for the three periods; also the temperature had begun to fall in 1890, although sun-spots were still at the minimum, and the temperature had begun to rise in 1892, although sun-spots had not yet reached their maximum.

Similar discrepancies occur in other parts of the curves, but when we compare the curves (C) and (D), that is to say, the combination of the effects of sun-spots and volcanic haze, with the mean maximum temperature for the United States, the correspondence of the curves is most striking.

CONCLUSION

It seems to me, in consideration of this, that there can be little question that the volcanic haze has very appreciably

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* I incline now to think a better result would have come if 5 were used instead of 6.

Photo by R. R. Rivera. By courtesy of The University of Chicago Press and the Journal of Geology

MOUNT COLIMA IN ACTION, MARCH 7, 1903

The column of ashes seems to reach to a height of 17 miles, or 89,760 feet. It is presumed that this notable eruption was largely responsible for the decrease in solar radiation noticeable in 1903 (see page 195).

influenced the march of temperature in the United States. When we take the march of temperature for the whole world the apparent effect is not so striking, but in this case there are so many conflicting influences at work that it is perhaps too much to expect so good an agreement.

In view of this slight preliminary study of temperatures, it seems to me that the question of the effect of volcanic haze on terrestrial temperature is well worth serious consideration.

Although a large group of stations may, by their contrary local influences, mask the influence of the haze, *I believe it will be found eventually that temperatures are influenced perhaps as much as several degrees by great periods of haziness, such as those produced by the volcanoes of 1883, 1888, and 1912.*

Certainly an agency capable of sending vast clouds of dust to a height of 20 miles in the air, there to be distributed by the winds all over the world, and to remain in suspension for months or years, causing the decrease of the direct radiation of the sun by as much as 20 per cent, is a climatic influence not to be ignored.

THE CHANGING MAP IN THE BALKANS

BY FREDERICK MOORE

AUTHOR OF "THE BALKAN TRAIL," AND CORRESPONDENT OF THE ASSOCIATED PRESS

A VERY definite settlement of the centuries-old Balkan Question promises to result from the war which the "Allies" have been conducting against the Ottoman Empire. The Turk has been driven not entirely back to Asia but far enough in that direction to terminate his power over subject European races. This is the solution for which those European countries not materially interested in the maintenance of the Ottoman régime have long been hoping.

Centuries ago the Turks set out from Asia Minor with the idea of conquering the world for their Prophet Mohammed. They carried their new faith east into Persia, India, and China, and west into Europe. In Europe they succeeded in driving their way as far as the gates of Vienna, subjugating all the peoples of Southeastern Europe except some few bands of hardy Serbs who took refuge in the fastnesses of the mountains that now make up the little kingdom of Montenegro.

THE TURKS CONQUERED, BUT FAILED TO CONVERT

But though the Turks conquered and subdued with the sword they found the peoples of Southeastern Europe who followed the Christianity of that day most hard-headed and unconvertible. Had the Turks adopted the method of the Arabs, who went across North Africa on the same mission and even entered Spain, they would have left no soul alive who did not say with them

> "There is no god but God, and Mohammed is His Prophet."

They did not desolate, however, to the same extent as the Arab; their method, though sufficiently terrible to blight the conquered countries and retard their progress for centuries, was never quite as drastic as the methods of other Mohammedans. The Turks are the best of the peoples who have accepted that uncompromising militant faith.

The territory which the Turks succeeded in overrunning was too vast to lay entirely waste and the people too numerous to exterminate. Those whom they could convert were made Mohammedans; the others became vassals and serfs, laboring for the conquerors, paying them tribute in money and in kind, and yielding up not only of their wordly possessions, as the Turk demanded, but also of their flesh and blood. Many of their daughters went at the Turks' will to Mohammedan harems, and for many years a tribute of their finest sons was also exacted.

In the early days of the conquest the Sultan's agents visited every four years the Christian villages under his domination and took away a fifth part of all the male children between the ages of six and nine, to be raised as Mohammedans and to form his corps of Janissary soldiers. Naturally, the strongest and finest boys were selected; however, being taken young, like many of the girls, no memories of parents or deep religious beliefs long affected them.

HOW THE TURKS IMPROVED THE RACE

By this system and by conversions (for many of the Christians went over to the new faith because of the privileges it offered, the foremost being the right to carry arms) the Turks added to their Semitic blood some of the finest manhood of the races of Southeastern Europe. Turks whose appearance is thoroughly European and Turks with fair hair and straight noses are to be distinguished throughout Western Turkey from the distinctive Semitic type; and some of the best brains in the recent Young Turk movement are European brains.

The infusion of European blood had a certain minor effect upon the character of the Turk, but the greater change came upon the converts and their offspring. The blight of the Mohammedan creed, which impairs all better civilizations that it touches, affected the Europeans only

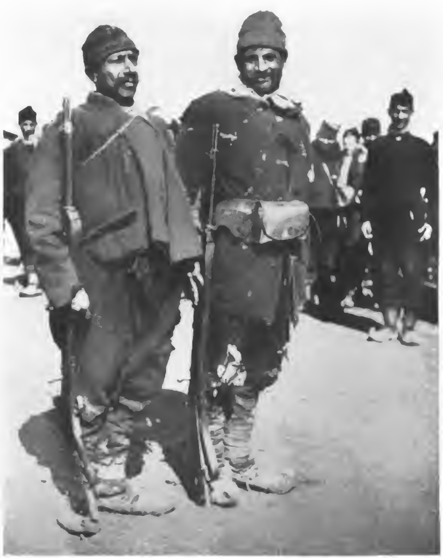


Photo by Frederick Moore

EASTERN GYPSIES, OR TZIGANES, WHO, LIKE ALL OTHER SUBJECTS OF KING PETER OF SERVIA, ARE REQUIRED TO CARRY ARMS

They had been called to the colors, but not yet uniformed when this picture was taken

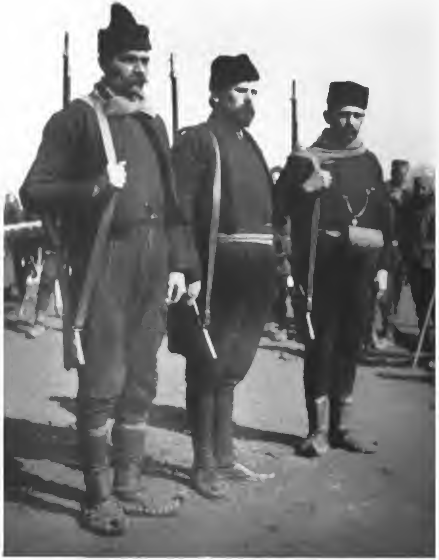


Photo by Frederick Moore

SERVIAN SOLDIERS WEARING NATIVE PEASANT COSTUME, HAVING RECEIVED NO UNIFORMS WHEN THIS PICTURE WAS TAKEN

Photo by Frederick Moore

SERVIAN PEASANTS, CALLED TO ARMS, SIGNING THE MUSTER-ROLL

less seriously than it had the Asiatics whom it reached.

When Europeans became Mohammedans they became to all intents Turks and called themselves such; they were no longer Greek, Servian, or Bulgarian, as the case might be. In spirit if not in blood they were wholly gone over to the other race. Such is the power of the Moslem faith!

But the conversions were not on the whole large. The great majority of the Christians remained steadfast, and persecutions, as they generally do, made the people more than ever obdurate. And so we find the Bulgarians, Greeks, Servians, and Albanians of European Turkey today hard-headed people in spite of their centuries of oppression, not only retaining their own faiths, but wearing such clothes as they wore in the mediæval days when they were conquered, and speaking not Turkish, but Servian, Greek, Bulgar, Albanian, and, among the Jews who took refuge from the persecutions in Spain, the Spanish language.

SEVEN RACES IN ONE LITTLE CITY

All these people, clinging fast to their own ideals and marrying only in their own faith, remain today in remarkable distinction one from another, seven races sometimes making up the population of one small city, and remaining distinct in facial appearance, distinct in dress, distinct in language, and reverencing at least three distinct beliefs, with the Christian religion divided within itself.

The retreat of the Turks from the Balkan Peninsula has been comparatively rapid. Gradually, sometimes unaided, sometimes with the assistance or entirely by the efforts of one or more of the great Powers, the conquered Christian peoples have regained their independence. The modern States of Rumania, Greece, Servia, and Bulgaria were carved in the past century out of the conquests of the Turk, and Montenegro, always independent, was given definite boundaries and recognition.

Slowly the question of Turkey in Eu-

Photo by Frederick Moore

ASIATIC TURKISH TROOPS IN OLD ZOUAVE UNIFORMS, SOCKS PULLED OVER TROUSERS, DRILLING

Notice physiognomies of these as compared with European types of Turks

rope had been narrowed down, until at the beginning of the present war the provinces of Albania, Macedonia, and the Adrianople vilayet (known in ancient times as Thrace) composed all the European territory remaining under the domination of the Sultan.

There was no reason why the Balkan Allies could not have driven the Turks out of Europe ten, or even twenty, years ago, had they been able to agree upon the division of the territory and had they been bold enough to defy the dictation of Europe,—which has been anxious always to avoid the dangers of a conflict between the great Powers. But because there were Greeks, Bulgarians, and Servians scattered over European Turkey, each small State, unduly ambitious, preferred to let the years slip by in the hope of some turn of politics among the Powers that would work in its favor.

At last, however, the leading statesmen if not the masses of the people of the Balkan States set aside their jealousies and rival ambitions, and, coming to an agreement early in 1912, entered in a few months into the present war confident of success.

THE ALLIES FORCE THE ISSUE

They had always reason or excuse for war. The Turk had never seriously reformed; he had not assimilated the conquered people, nor had he done what has made the English powerful among foreign races over which they rule—he had not governed justly or well. In the case of each of the Allied States there were people of their own blood and religion just beyond their frontiers being constantly persecuted and massacred.

When the States were ready for war they made demands of Turkey which they knew the pride and arrogance of the Mohammedan, who had held them so long in subjection, could not accept. They demanded no less than the right of interference in the control of affairs in European Turkey, in order to put a stop to

Photo by Frederick Moore

TURKISH RECRUITS ARRIVING IN SALONIKI FROM ANATOLIA

the intolerable conditions under which their fellow-Christians were oppressed.

The Turkish people clamored for war, and the wiser heads among them understood that war was inevitable. Those wiser heads had come to realize that they were unable as a race to rule subject peoples except by the sword. They knew, too, that each of the Balkan States—and this was perhaps the most important factor—was ambitious to annex territory.

Underlying these motives of the Allies was a deep desire for vengeance on the Turk. There was not a Christian family in European Turkey whose property and hard-earned money had not at some time been taken by some Mohammedan; not a family without a record of parents slaughtered in massacre; not one which had not mourned a daughter enticed or taken forcefully to the harem of some lustful Turk. And what recourse was there for the Christians in a Turkish court of justice?

WAR THE ONLY SOLUTION

The situation was one that only war could settle. The Turks saw that to accede to the demands of the Allies would

Photo by Frederick Moore

A SECTION OF THE TURKISH ARMY ON THE MARCH NEAR THE CHATALDJA LINES

be only to defer the day of trying the issue with modern arms.

If the Turks admitted European agents for the purpose of reforms within their own boundaries, and gave equal rights to Christian Bulgar, Greek, and Servian, they would soon be the subject and not the ruling people. Numerically the Christians of their European provinces outnumbered them and they were also quicker of wit. The situation was one of an inferior continuing to hold back several advancing races.

The Turks decided to accept war in place of the terms of the Allies. They were confident of holding the Allies in check if not of driving them back beyond their borders. Regiment upon regiment of recruits brought up from Asia Minor passed through Constantinople crying "On to Sofia!" And one of the Turkish newspapers boasted that in future years visitors to Bulgaria would cross the plain of Sofia and say, looking over a desert waste, "This was once the site of the Bulgarian capital."

Europeans generally, even military attachés located at Constantinople, believed with the Turks that the Allies would fall back before a terrible Turkish onslaught. Foreigners based their opinion on two things—on the name and reputation of the Turk as a fighting man and on the fact that the Greeks had been

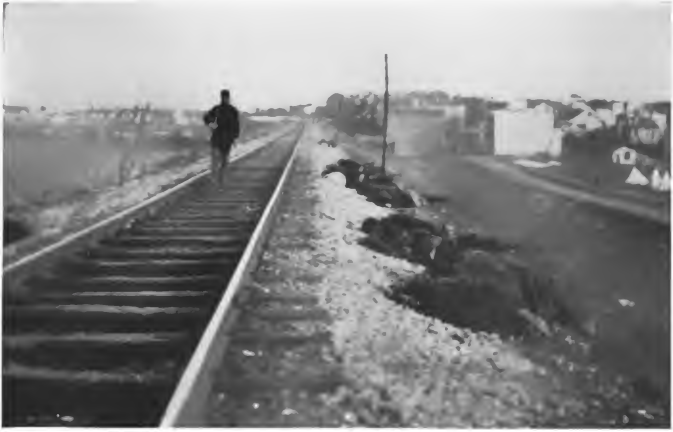


Photo by Frederick Moore

CHOLERA VICTIMS THROWN FROM THE TRAINS WHICH CAME INTO CONSTANTINOPLE DAILY FOR WEEKS WITH SICK AND WOUNDED FROM THE LINES (SEE P. 215)

crushed by the Turks in battle not many years before.

THE ALLIES' SCHEME FAILS

When the Turks rejected the proposals of the newly Allied States of what they termed interference in their internal affairs, not all of the Allies declared war but only little Montenegro with her army of about 40,000 men—40,000 against the Turks' paper million!

In this preliminary declaration of war by Montenegro alone there must have been a strategical design on the part of the Allies. They evidently intended to draw a large part of the Turkish army off to the western extremity of the military area, thereby weakening the armies of Turkey that stood between the Bulgarian border and Constantinople and giving the Bulgarian forces the best chance of a successful rush, as they planned, upon the Turkish capital.

But the Turkish government, no doubt advised by their foreign experts, left the garrisons of Scutari and other Turkish towns in the neighborhood of Montenegro to take care of themselves and reinforced primarily the army that was to oppose the Bulgarians. The Turkish plan was apparently to defeat the Bulgarians first, and, having dealt with this most formidable of their enemies, to turn their attention later to the punishment of the other States.

But the Turks were not even equal to the first of the tasks they set themselves. They are a slow-moving race. I think it was Moltke who said that the Turks begin to defend a position only when another army would consider capitulating.

In the present war the Turk has shown a number of times how slowly he learns a lesson and how often he begins to act upon an experience too late. Nevertheless, as in the case at Chataldja and in the historic example of Plevna, he will defend too late with remarkable determination.

BULGARIA MAKES A RECORD IN MOBILIZATION

In the case of the Bulgarian, the army is a thing of speed and French-like dash. The Bulgarian officers, in preparing as they have for years for this war, devoured the history of Napoleon and planned to emulate his quickness of

Photo by Frederick Moore

DEFEATED TURKISH ARMY RETREATING FROM LULIE BOURGAS TOWARD THE CHATALDJA LINES

During this retreat the Turks suffered terribly. The weather was cold and wet, the roads muddy, and the commissariat gave out. Many soldiers threw away their arms and lay down in the mud to die of exhaustion and starvation

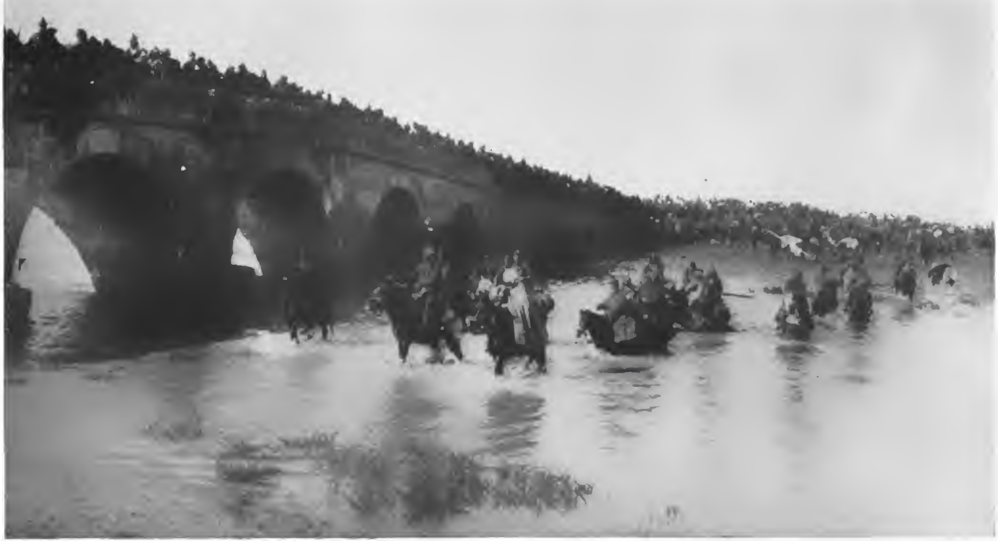


Photo by Frederick Moore

RETREATING TURKISH ARMY (AFTER THE DEFEATS IN THE THRACIAN PLAINS) CROWDING UPON AN ANCIENT BRIDGE

The retreat to Chataldja was a disorderly rout. Many officers left their men to save themselves as best they could. No discipline was preserved, and it was not until the line of forts was reached that the army recovered its morale

Photo by Frederick Moore

A SERVIAN KOMMITTADJI (BANDSMAN), THE CHIEF, VOIVODA PETKO

One of the Servian revolutionists of Macedonia who, after operating for years in Macedonia, finally served as guerillas in the present war.

movement. It was always said round the club in Sofia that when the Bulgarians struck their movement would be hard and fast against Constantinople. Consider how this little nation, with only about 3 million inhabitants, which the average American was wont to consider a primitive country of "Dagos," mobilized their army of 350,000 men. In two weeks after the call to arms their forces were camped behind the frontier mountains ready to move through the border passes on word from Sofia that peace was definitely broken.

Those who know something of the Turk can picture him at the front on receiving news that his own government had declared war against the Bulgarians and Servians, not waiting for those enemies to follow with Greece the example of Montenegro.

The news gave the Turkish soldier a measure of keen satisfaction. But, slow-moving and generally lazy, his camp was not stirred by the news as was that of the Bulgar. Slowly he gathered in little groups with his fellow-soldiers, knelt and gave thanks to Allah, made coffee and rolled cigarettes, and spent a happy night round a comfortable camp-fire discussing how he would make the Bulgarian girls dance to his music when he entered Bulgaria and the Bulgar men deserted their women and children to him.

But the Turk himself and not the Bulgar was the man who was going to hop and skip to get out of the way of the enemy. The Bulgars came through the passes with speed that amazed the military authorities of other nations, and, after three quick battles following rapidly upon each other, the Turkish army was driven back to the sheltering positions of the Chataldja lines, about 30 miles from Constantinople.

THE BULGARIANS AVOID THE TRAP

It was evidently the opinion of the Turkish generals, and also of the Ger-

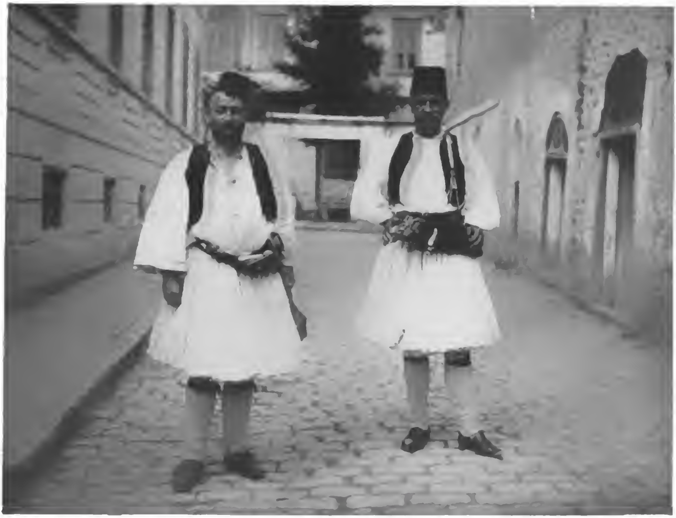


Photo by Frederick Moore

ALBANIAN KAVASSES, DRESSED IN THE SAME "FUSTENELLA," OR PLEATED SKIRT, THAT THE NORTHERN GREEK WEARS

The Kavass is the armed watchman whom the foreign embassies or consulates keep to protect them and their residences in Turkey. Note their pistols

man engineers and military officers who had aided in the construction of the fortifications of Adrianople, that the Bulgarians would break their backs, so to speak, there at Adrianople, just as the Russians had spent so much of their energy and their time at Plevna in the war of 1877 before proceeding on to Constantinople. While the Bulgarians stormed and invested the position at Adrianople the Turks planned to bring up their great hordes of men—it would take several months, to be sure—from Asia Minor.

The Bulgarians, however, did not stop at Adrianople. Contenting themselves with masking the fortresses there with only sufficient men to prevent the garrison escaping or getting in further supplies, they pushed on at once toward their goal.

And what was the result of their getting to the Chataldja entrenchments within three weeks after they first charged the Turkish lines? The result was amazing; so terrific that almost any nation would have made peace without another battle and would have paid whatever indemnity the Allies saw fit to demand. But the soul of the Turk is of a different stuff. His religion is not a thing that considers seriously a waste of this world's flesh and blood.

The Turks had had in all probably 400,000 armed men scattered over European Turkey, yet they could muster on the Chataldja lines but 70,000 effectives for the defense of Constantinople. The others are to be accounted for in various ways; some had been killed in battle, some had died or become ineffective by starvation and disease, some had been

Photo by Frederick Moore

GREEK KILTED SOLDIERS, THE SPECIAL BODY-GUARD OF THE KING OF GREECE

Photo by Frederick Moore

ALBANIAN BRIGANDS

Released from prison in one of the "general amnesties" which the Turkish government was wont to declare with ridiculous frequency under Abdul Hamid, who was often almost as lenient as he was severe.

Photo by Frederick Moore

PART OF THE TURKISH GARRISON OF MONASTIR MOVING OUT OF THE CITY (IN A FORMER CAMPAIGN)

made prisoners by the armies of the several Allies, some had been locked up in garrisons like those of Adrianople, Jannina, and Scutari, which must in time capitulate, and others had been cut off from retreat and compelled to take to the fastnesses of the mountains.

CHATALDJA AN IDEAL PLACE FOR DEFENSE

Yet with these 70,000 men the Turks were able to hold their position at Chataldja. There they began to fight. In this cramped position the Bulgarians were no longer able with swift movements to outflank them. The sea on either side and the heavy guns of Turkish cruisers confining the attack to a limited central plain, permitted the Turkish soldier to occupy his trenches and redoubts and fire steadily from them at the oncoming Bulgarian infantry.

It is a question whether the Bulgarians, now that the London conference has failed and fighting has been renewed, can succeed in taking the Chataldja lines. Their capture seems possible only by a slow tedious mining and trenching process; in other words, only by laborious and sacrificing effort such as the Japanese devoted to the taking of Port Arthur.

The questions have often been put to me why the Turks did so badly in this war and whether they are no longer the capable warriors they were in former days.

My opinion is that the reputation of the Turks as a whole rests upon the heroic work of a few ardent leaders,

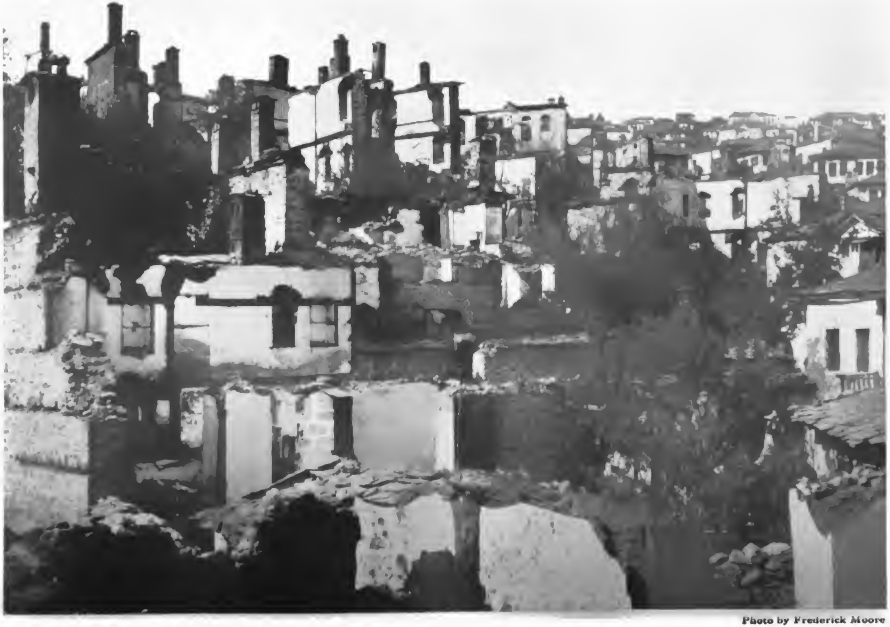


Photo by Frederick Moore

ONE OF THE WEALTHIEST CHRISTIAN TOWNS OF INTERIOR MACEDONIA, KRUSHEVO, WHICH WAS DESTROYED BY THE TURKS WHEN SUPPRESSING A CHRISTIAN RISING SEVERAL YEARS AGO

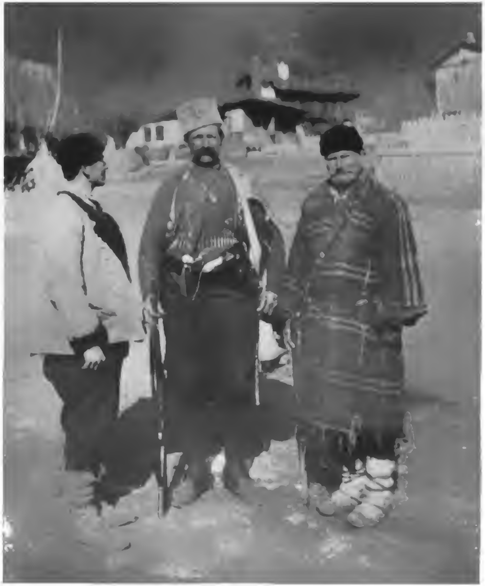


Photo by Frederick Moore

TYPES OF BRIGANDS OR BULGAR MACEDONIAN INSURGENTS WHO FOR YEARS KEPT UP A REVOLUTION AGAINST THE TURK, TILL AT LAST THE ALLIED STATES CAME TO THEIR ASSISTANCE AND DROVE THE TURKS OUT OF EUROPE

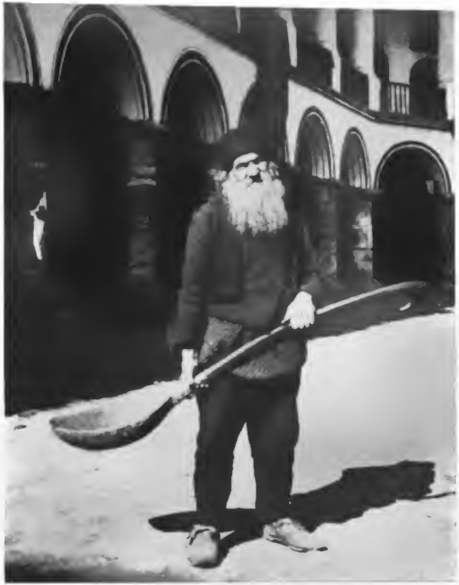


Photo by Frederick Moore

THE OLD COOK OF RILA MONASTERY, IN BULGARIA, WHO, DURING PILGRIMAGES TO THIS SHRINE, SERVES OUT SOUP TO EACH FAMILY FROM A HUGE CALDRON WITH THIS GREAT WOODEN SPOON

Photo by Frederick Moore

MONTENEGRIN SOLDIERS ON THE HEIGHTS ABOVE THE AUSTRIAN COAST

partisans of the faith, who encouraged and employed the spirit of Islam, which the great majority of the ignorant people of Turkey possess. Some of the Turks fight well—as, for instance, at Adrianople, at Scutari, and at Jannina—and some do not.

The trouble rests with the organization of the Turkish government, which is so incompetent and corrupt that no standard of fighting efficiency can be maintained. If any one army or single garrison fights well it is because that garrison is properly controlled and led.

THE REASON WHY THE TURK HAS FAILED

As a whole the nation cannot and will not, because of internal political jealousies, work in unison, work zealously and honestly. The killing of Nazim Pasha is a case in point, and also the memorable delinquency of the palace clique in ignoring persistently the appeals of Osman Pasha, the commander of Plevna, for relief and reinforcements in 1877. Many of the Turks would rather see the enemy win than that their political rivals should hold office.

As this war has brought out, there are great defects of organization in the Turkish army. Whole regiments, for instance, were sent to the front during the mobilization with few or no officers, the officers joining the men in the camp or even on the battlefield.

In former days, as, for example, at Plevna—as no doubt in Adrianople, Scutari, and Jannina today—men and officers shared the hardships in common, suffered together, and sympathized one with another. Too many officers of the new school, who reside mostly at Constantinople, do not know their men, and are consequently mistrusted by them.

Photo by Frederick Moore

ON THE (FORMER) TURKO-BULGARIAN BORDER: A BRIDGE OVER THE RIVER STRUMA, THE CENTER OF WHICH WAS THE BORDER LINE; A TURKISH SOLDIER ON THE LEFT AND A BULGARIAN ON THE RIGHT

The foreign-educated officer of the present day spends too much of his time in the cafés and the foreign restaurants of Pera, and too little in the camp of his soldiers.

I saw on one occasion a young Turkish doctor, immaculately dressed, wearing a high collar on the field, refuse to touch a line of 20 or 30 invalided men because they were too dirty for him to handle. To my knowledge these men had had hardly sufficient water to drink and no opportunity whatever to wash.

THE HORROR OF THE CHOLERA CAMPS

Conditions in the cholera camps—which I had occasion to describe in my dispatches to the Associated Press during the month of November—were final proof, if proof were needed, of the hopeless incapacity of the Turks. There is a measure of excuse even for massacres, Mohammedans believing that they do not offend God by slaughtering "infidels;" but could there be any excuse for permitting thousands of their own soldiers to die without taking the trouble to give them water?

The scene at San Stefano was horrible almost beyond conception. For weeks train-loads not only of sick but wounded men and men with frozen feet were dumped down at this summer watering place on the Marmora. Those who were able to walk entered the cordon of death without assistance; those unable were

Photo by Frederick Moore

Photo by Frederick Moore

SWEARING TO A BARGAIN

Being unable to write, men who buy and sell ponies or other animals are sworn to a bargain (over which they shake hands) by a third man

pushed off the cars and lay where they fell, or rolled down the steep railway embankment some 20 feet or more to the level ground. For a fortnight or several weeks practically no attention was paid to the victims put into this camp.

On my first visit to the place, in the company of Mr. Hofman Philip, first secretary of the American Embassy, and Major Clyde S. Ford, of the United States Army, there were probably eight Red Crescent men standing idle among the dead and dying, who lay huddled together in groups on the open ground, endeavoring to get, by close contact, what shelter they could from the winter winds.

We saw one man praying, whose overcoat blew over his head, he was too feeble to replace it, and yet the men who wore the Red Crescent did not trouble to help him. They did not trouble to place a stone under the heads of many who might have been more comfortable for even so hard a pillow.

The victims lay, that first day of our visit, on the hard, cold ground for the most part, unsheltered even from the wind. There were not more than a dozen tents and they were crowded with corpses and men who would soon be corpses. In one tent Major Ford counted twenty-two. The Red Crescent men shrugged their shoulders as we approached, as much as to say, "What can any one do?"

Occasionally a water cart would pass, a barrel on wheels drawn by a pony or donkey, and the driver would call out "su!" Those who were able to rise and respond to this cry of water got a little. They fought and fumbled for it, men sometimes falling in the mêlée. Those who wanted bread and could respond when the call came of "ekmek" went likewise to the cart and got it for themselves.

I saw one man at a deep well trying, evidently, to wet the end of a long sash which he had unwound from his waist in

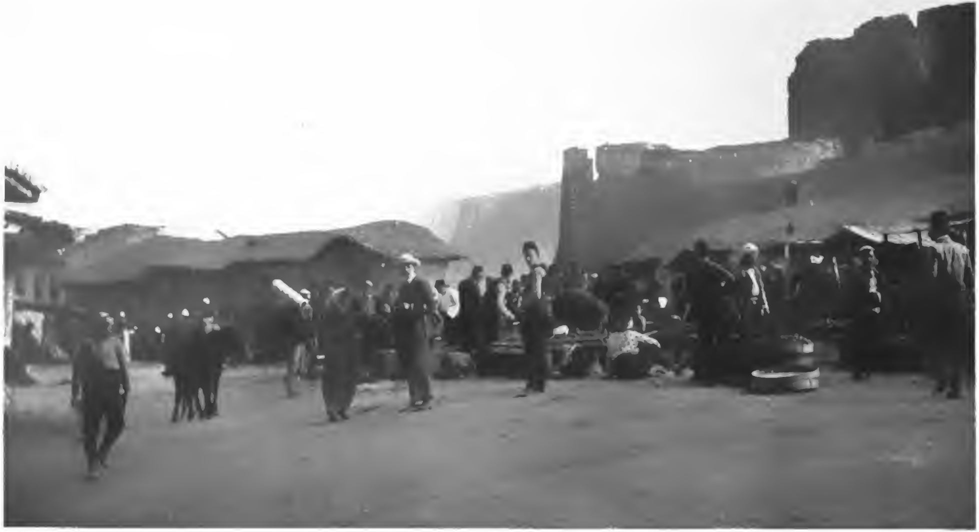


Photo by Frederick Moore

HIGH UP ON THE MOUNTAIN CITADEL OF USKUB, WHERE THE WEEKLY MARKET OR FAIR IS HELD

From Uskub the Turks fled without making a stand before the Servians; their departure from their post of duty was, in this case, in marked contrast to their determined stand in Adrianople and on the Chataldja lines order, I suppose, to moisten his parched lips. The water cart did not come his way.

THE TURK REFUSES AID FOR HIS OWN WOUNDED

Several men lay on a manure pile, in which one was feebly digging with his fingers a trough in which he might lie and thus keep warm. Several round this manure heap lifted their heads and called out to us in Turkish. Our kavass (an embassy attendant) told us that they said, "We are sick men and no one gives us water and no one gives bread." Their appeal to us in the sight of men of their own faith seemed to me a remarkable recognition of a somewhat better condition of humanity existing among men of the Christian nations.

There was no excuse for this terrible condition, which existed not only at San Stefano, but on the Chataldja lines and even in Constantinople. The government had brought the cholera over to Europe from Asia Minor in the mobilization, and then brought it into Constantinople, where sick and wounded were crowded into the mosques. At Constantinople there was an abundance of provisions and an endless supply could be got in from the several seas that wash the Empire's shores. There were also many foreign Red Cross volunteers in the city, who were not permitted to go to the front!

The Turk likes to conduct his affairs or leave them to conduct themselves without the interference of foreigners, and though always polite he availed himself of the foreign medical officers and nurses only when they forced themselves upon him. In order to get patients some of the volunteer surgeons were compelled to meet the incoming trains and take away as many wounded men as they could accommodate in hospitals which they improvised.

The condition at San Stefano was so pitiful that Mr. Philip and Major Ford, together with the Rev. Robert Frew, a Scotsman, and Mr. Maurice Baring, an Englishman, went out there with the idea of saving at least some of the wounded and injured who were not stricken with cholera. Mere segregation and feeding and watering hundreds of those cordoned at San Stefano would save their lives.

The work which these men took up was financed by Mrs. Rockhill, wife of the American Ambassador, with American Red Cross funds and other collections. Soon the Turks, shamed at the sight of foreigners doing their work, sent out a few officers and a number of men and made a feeble pretense of medical work, and soon foreign Red Cross men and some Austrian Sisters of Charity went out to assist at the work.

TWO HEROIC WOMEN

But the pioneers of all were two old women, one Swiss, the other a Hungarian, both frail old ladies of more than sixty years, whom Philip's party on their arrival found already working among the mass of dying and dead humanity. These old ladies, governesses living in San Stefano, went into the cholera cordon, taking their own savings of money and working with their own hands, not even troubling to notify the foreign embassies of their action, much less appealing for protection. Miss Alt and Madame Schneider were the names of these ladies.

THE DILEMMA OF THE YOUNG TURKS

The Young Turk movement, which promised much a few years ago, seems doomed to failure. The original leaders of this reform movement were men affected by European education—almost entirely men who had lived, if they had not also studied, abroad. The majority had returned home with their faith in Mohammed distinctly shaken.

But though they had lost their zeal for the creed of Islam their sojourns abroad had not made Christians of them. Against their natural enemies, the Balkan States, they were as bitter as ever. Their religion had given place to patriotism. Instead of replying in the manner of the "true believer" to the question of their nationality, namely, that they were Moslems, they would answer now, if you inquired, that they were Ottomans.

Photo by Frederick Moore

STREET SWEEPERS IN SALONIKI

The White Tower in the background is where the ancient pre-Turkish wall, probably built by the Crusaders, met the sea

They succeeded, as is well known, in overthrowing the Sultan Abdul Hamid, whose tyrannical régime bore only less heavily upon Turks than upon Christians.

Having come into power (in 1908) they were faced with the problem of the faith: Should they denounce Mohammedanism or support it?

They tried a middle course, attempting to give to Christians and Jews equal rights with their own people. This impossible combination naturally failed.

There is now left to them the alternative of supporting or denouncing Mohammedanism. By continuing that faith as the soul of the empire they maintain a stifling idea, a state of mind that cannot progress sufficiently to keep pace with the advancement of the countries which, being "infidel," all true followers of the Prophet must scorn and oppose.

On the other hand, should the Young Turks attempt and succeed in destroying the Mohammedan faith—a thing they will not do—the result would be the break-up of the Empire, for Arabs, Syrians, Anatolians, Kurds, and others are bound to the Turks only by the "faith," and because the Sultan at Constantinople is their Caliph, their religious chief.

It is regrettable that though the Balkan question is solved and the people of European Turkey liberated, there still remain many Christians, notably the Armenians, in Asia Minor, for whom independence or even a measure of relief seems impossible. That these Christians of Asia Minor will suffer further, as a result of the present war, there seems little doubt.

THE AMBITIONS OF BULGARIANS

The Bulgarians have now by conquest come down to Ægean Sea. They speak already of the navy they intend to build,

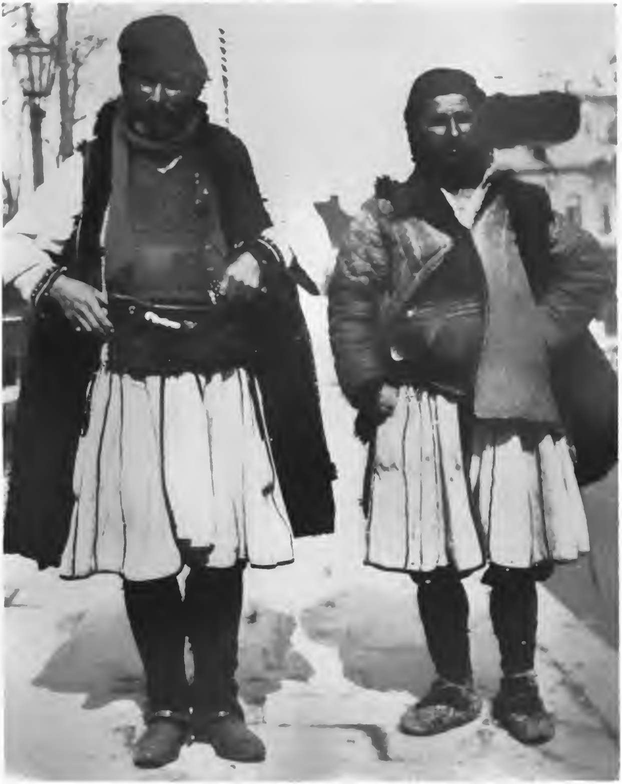


Photo by Frederick Moore

WALLACHIANS (OR KUTSO-VLACHS, AS THEY ARE KNOWN IN MACEDONIA), ONE OF THE SEVEN DISTINCT RACES OF MACEDONIA

The people whose blood affinity with the Rumanians gives Rumania excuse for claiming territorial compensation for their annexation by Bulgaria

planning to have ships in both the Black Sea and the Ægean, and thereby controlling if not possessing the great waterway that joins these two seas. A glance at the map will show what a splendid position the Bulgarian army as well as the navy will hold in any future war that may arise with Turkey.

In offering back to Turkey, as the Bulgarians did at the abortive London conference, a sufficient strip of territory to connect Constantinople and the Darda-

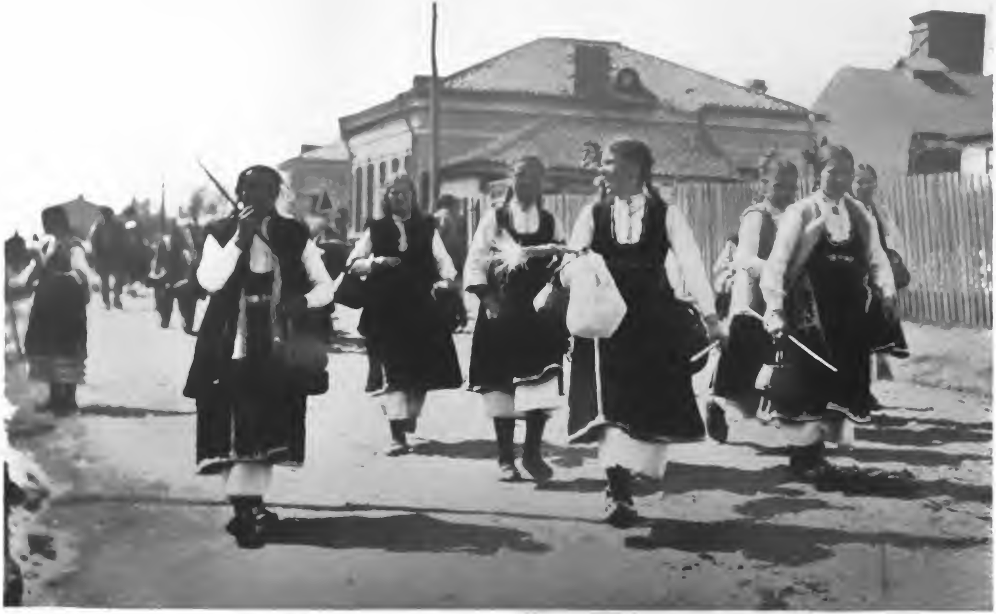


Photo by Frederick Moore

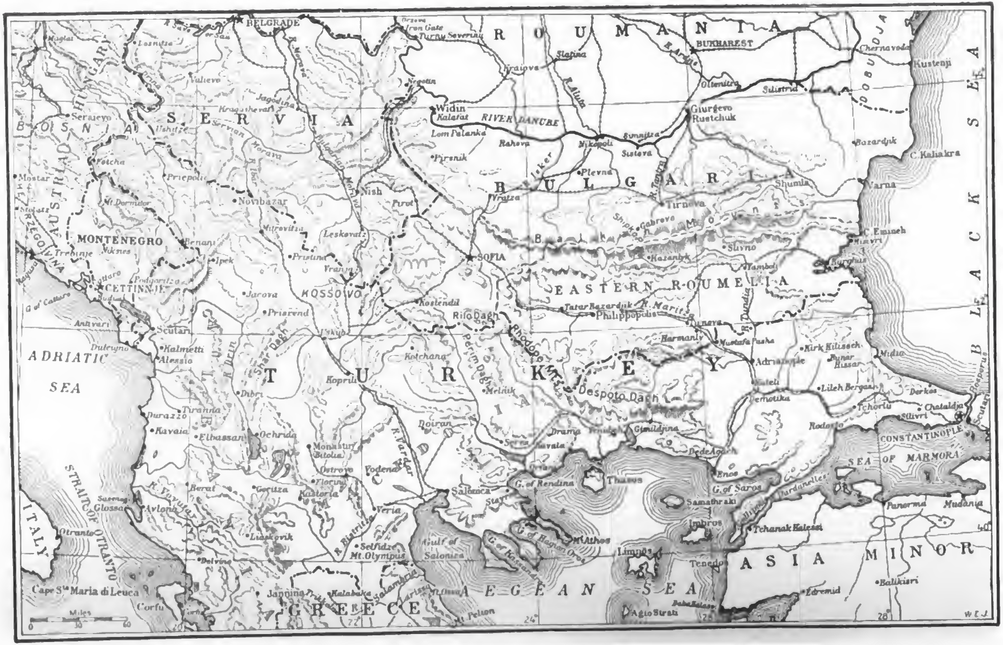
BULGARIAN PEASANT GIRLS ON THEIR WAY TO MARKET IN SOFIA

Photo by Frederick Moore

SLAV PEASANTS OF BOSNIA IN THE AUSTRO-HUNGARIAN EMPIRE

nelles, they gave evidence of a desire to keep out of the high politics of Europe. By occupying the coveted city of Constantinople and the Dardanelles—that is to say, all of European Turkey—the Bulgarians would at once enter the sphere of politics which causes the Great Powers to form into two balancing groups in order to maintain the peace of Europe. The Bulgarians seem, curiously, to have little ambition to hold the city, which, as one of their leading statesmen first pointed out to me, has caused the ruin and downfall of every empire that has possessed it.

The Bulgarians, unlike the Greeks, are not dreamers and have no imperial aspirations. They are very hard-headed, as every student who has written of them has declared. Even more than the



MAP OF THE BALKAN STATES

Photo by Frederick Moore

THE TURK GOES OUT OF EUROPE AS HE CAME

Long lines of these arabas pass daily over the bridges of the Golden Horn and are conveyed to the Asiatic shores by boat

Servians and the Montenegrins, who are likewise Slavs, they are most practical.

WHAT THE SLAV QUESTION MEANS

When we take up the Slav question we enter at once into the politics of Europe. Why have the European Powers the right to interfere in Balkan affairs?

It is in the first instance the right of might; but most of the Powers have also very definite reason or excuse.

England, the supporter of the Turks in former years, aided them then because the alternative of their occupation of Constantinople seemed to be an occupation by the Russians; and England, in spite of the present *entente* with France and Russia, has never ceased to guard against the Russians achieving their ambition to acquire an outlet to a southern sea.

As is well known, England's permanent policy in European affairs is to maintain a divided continent in order that she may remain supreme. She is always to be found balancing the rival European camps, thereby keeping the peace by placing her navy on the side of the weaker group. Hostile to Russia prior to the Japanese war, she now forms the Triple Entente by supporting the Franco-Russian Alliance, the Triple Alliance of Germany, Austria-Hungary, and Italy being, she believes, the present danger to European peace. Hostile to Russia when Russia's ambition was to possess Constantinople, England is now hostile to Austria-Hungary and her supporter, Germany, who together apparently covet the possession of Saloniki and hope for the extension of a German shaft of territory from the Baltic Sea to the Ægean.

England is well satisfied that the Balkan States are victorious in the present war, though she opposed them when she feared that they, being Slavs like the Russians, would eventually be annexed by Russia. But the three Slav States of Southeastern Europe have given very clear proof to the contrary, and as long as they desire their own liberty of action and independence Great Britain will allow her Christian sympathies to support those minor States against the Turks.

WHY AUSTRIA INTERVENES

The position of Austria-Hungary, supported by Germany in her interference on behalf of the Albanians, is one of serious politics as well as of thwarted ambitions. The evident intention of the victorious Balkan States was to divide Albania—an important territory, though peopled only by a primitive mountain race and more or less sparsely settled. But the accomplishment of this plan would unite the Montenegrins and the Servians, on the south of Austria, within whose borders are many Slavs.

Austria-Hungary desires to keep any confederacy of the Southern Slavs feeble, because though these Southern Slavs intend to maintain their independence, they are, nevertheless, in sympathy with Russia, the great Slav nation, whose religion, like their own, is Orthodox—that is to say, of the same form as the Greek.

The great balance of racial power in Europe being Germanic and Slav, the Germanic Powers must prevent a strong Slav confederacy south of them as long as their northern frontier is permanently open to a Russian menace. Furthermore, by maintaining an intact Albania, which Austria will support and assist for political purposes, she may prepare for the future absorption by herself of this section, at least, of Turkey in Europe.

IS RUMANIA'S CLAIM JUST?

It is because Rumania is not Slavic, yet lies geographically between Russia and the Southern Slavs, that she naturally adheres in sympathy to the Germanic Alliance. Rumania's claim for territorial compensation from Bulgaria is based on the fact that many settlements of Rumanians, not emigrants from Rumania, but remnants evidently of ancient Roman invasions of the Balkan Peninsula, will be annexed by Bulgaria with her share of the conquered territory of Macedonia and the Adrianople vilayet.

With the new order of things that must come soon after the several countries are able to mark out their new border lines and extend their respective governments, the various scattered settlements of Bulgars, Serbs, Albanians, Greeks, and perhaps even Rumanians (or, as they are known in Macedonia, Vlachs) will naturally, to some extent, shift themselves behind the respective border lines of the races with which they are to become assimilated.

The Tziganes, or gypsies—of whom there are very many—will be content to live anywhere, and there will be no difficulty of politics or national ambitions arising from their presence.

Likewise, there will be no difficulties save those that exist already in Balkan countries, with the Spanish Jews, who, as I have said, took refuge in Turkey in great numbers during the period of persecution in Spain.

THE TURK FORCED BACK TO ASIA

As for the Turk, he will trek back in great numbers to Asia, selling out his lands for what he can get or allowing them to be taken from him, for there is much vindictive feeling among the Christians. He will dispense with the question of compensation—being a fatalist—as the will of Allah.

He will make his way back to Asia as he came away, centuries ago, little changed by his association with the people of Europe—whom he has kept as he found them, in a medieval condition, with all the barbarity of medieval Europe, with all its picturesqueness, its color, squalor, and unthinking faith.

The Turk is to be seen already moving toward the Bosphorus. Many thousands went away, fleeing before their retreating army, leading their double teams of buffaloes or oxen, behind which creeped the lumbering, four-wheeled arabas, laden with the remnants of their possessions, and with their veiled women in black and their children gaily clad in striking contrast.

Will the Turk change now, and progress and reform? That is a question which I should answer in the negative. He is a Moslem, and the soul of the true Moslem is indifferent to progress.

But for the enlarged Balkan States it seems safe to predict rapid development along modern lines, for we have seen how all of them under great difficulties have already fulfilled partially, at least, their aspirations to adopt the civilizing institutions of Europe and to advance in education, morals, and material welfare.

THE COUNTRIES OF THE CARIBBEAN

By William Joseph Showalter

THE wonderful changes that will be wrought on the countries of the Caribbean region by the completed Panama Canal are beginning to be evident through the plans these countries are making to capitalize on the advantages it brings to them. Everywhere there is anticipation that the completion of the canal is going to bring in a great stream of capital for development purposes, and that an era of unprecedented growth and expansion will result.

Such a desirable outcome will take place in some of these countries, but not in all of them; for, until capital is made safe in any country, it will not come in, and there seems to be no prospect of such an issue of affairs in many of the countries of this region.

Nowhere else in the world has Nature been more bountiful in her blessings of natural resources than in the Caribbean region. Everything that her treasure-house holds has been bestowed with lavish, and also with impartial, hand. Some one has observed that if you tickle the ground with a hoe it smiles back with a yam, and certain it is that in any one of these countries the ground of natural resources may be tickled with the hoe of foreign capital and it smiles back with yams of wealth.

These countries are nearly all favored alike in natural wealth, but there is a vast difference in the development of that wealth—a difference that may be attributed almost wholly to the character of the governments in the respective countries.

POVERTY AND MISRULE DWELL TOGETHER

In some of these lands the milk and honey of plenty flows in a bountiful stream. Others are in wretched poverty, where the masses never have enough to keep the gaunt wolf of hunger from gnawing at their vitals day and night and year in and year out. In traveling through these countries one is impressed with the fact that prosperity abides with good rule and poverty dwells with misrule.

Starting out with the easily demonstrated fact that there is very little difference between these countries in their natural resources, it is interesting to look around and notice what a vast difference there is in the use that is being made of this natural wealth. One needs not go out of the confines of Central America to see this. It would require six Salvadors to make one Honduras, and yet Salvador has three times as much population and three times as much foreign commerce as Honduras.

Costa Rica is less than half as big as Nicaragua, and yet it has three times as much foreign commerce as Nicaragua.

And yet, when Salvador and Costa Rica are compared with Porto Rico, they in turn seem to be slow in their development. Porto Rico is so small that seven islands like it would be required to cover an area equal to that of Costa Rica, yet it has a foreign trade five times as great as that of the Banana Empire. Porto Rico is less than half as large as Salvador, yet it has a foreign trade seven times as great.

WHY LITTLE PORTO RICO HAS PROGRESSED

Little Porto Rico is so small that it could be buried in a single Central American lake; it would take 57 islands of its size to equal Central America in area, and yet Porto Rico produces more foreign trade than all Central America together from Tehuantepec to Colombia. The reason? Because Porto Rico has an ideal government. The trade of the island has nearly quintupled since Uncle Sam took possession there. The number of children enrolled in school has increased sixfold. The wages of the laboring class has multiplied threefold.

We read of Porto Rico's present prosperity in every page of the record of its expanding industry. It is seen in the sugar fields, where four tons of sugar are produced where one was a dozen

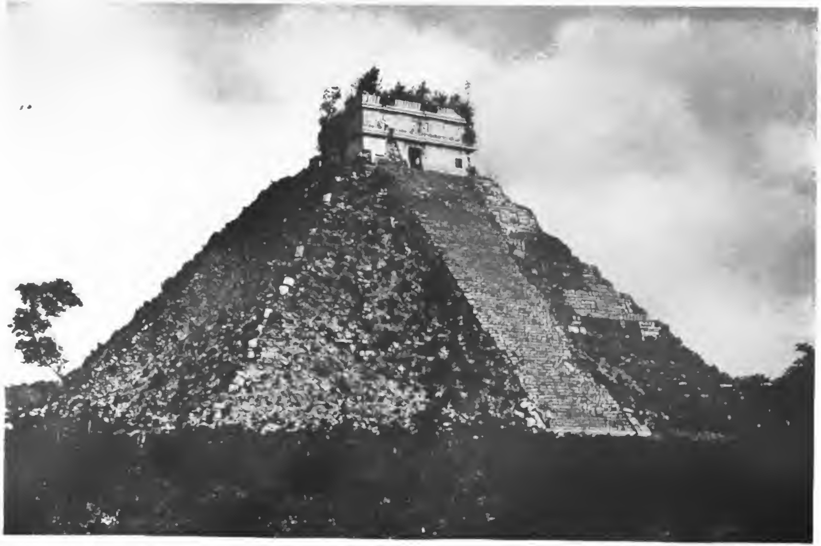


Photo from W. H. Holmes, U. S. National Museum

THE PYRAMID TEMPLE OF EL CASTILLO, YUCATAN

This is one of the finest pyramid temples in all Mexico. It is 80 feet high and 200 feet square at its base. It fronts a little east of due north and has stairways on all four sides. The walls of the temple which occupy the apex are 3 feet thick and are of plain masonry, but the pillars and portals are covered with sculpture in relief. A curious, warlike, human figure and colossal serpent heads are frequently repeated in the scheme of decoration, and the temple was possibly dedicated to the war god of the Itzas.

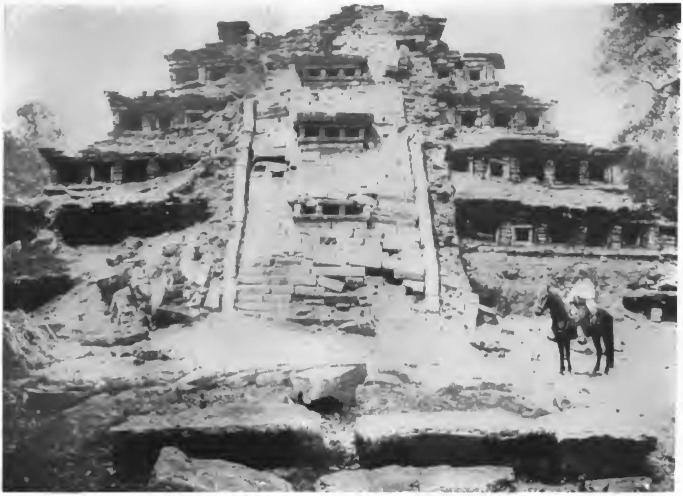


Photo from W. H. Holmes, U. S. National Museum

THE PYRAMID TEMPLE OF EL TAJIN

This pyramid temple, situated at Papantla, in the province of Vera Cruz, Mexico, presents a feature found in no other pyramid. It is constructed of earth, dressed with stone, and is solid throughout. With the exception of the space reserved for the stairway, the pyramid is faced on all four sides with a series of stone niches apparently designed to receive statues. This feature is unique. The temple proper, which crowned the pyramid, has now disappeared.

years ago, and where the Porto Rican people receive $6 for exported sugar where they received $1 only a dozen years before. It is seen in the expansion of the coffee fincas, where production has quadrupled since the beginning of the century. It is seen in the growth of the fruit-export business, where the production of oranges increased sevenfold in ten years, pineapples twenty-fold in four years, and grapefruit twenty-five-fold in three years.

Wherever one turns Porto Rico is extending its sugar fields, planting new pineapple plantations, establishing new coffee fincas, and laying out new citrus-fruit groves. And given a free entrance of their products to the markets of the United States, products raised where frosts never threaten and where labor is abundant and cheap, Porto Rico is destined to become a great competitor with Florida and southern California in supplying our tropical and semi-tropical fruits.

The crusade which was initiated and originally directed by the U. S. medical officers against the hookworm disease in Porto Rico has been a godsend to the suffering people of the island. Formerly practically the entire population of Porto Rico suffered from this wasting affliction. Hundreds of thousands of cases have since been treated and the majority of them cured. Forty-five dispensaries are maintained throughout the island, and in a single year 49,000 cases have been treated, out of which 19,000 complete and 7,000 partial cures were made. There still remain some 200,000 cases in the

Photo from W. H. Holmes, U. S. National Museum

A PREHISTORIC WATER GOD

This enormous serpent is found sculptured on the rock on a hillside near the town of Fuente, in Mexico. It is represented as if crawling out of the spring, which here issues from the rocks. It is 20 feet in length and its tail is hidden in the spring. Archeologists are of the opinion that it represents a Mexican water god.

island, but they are being reduced at the rate of about 12,000 a year. The treatment is free to the people, the expense being borne by the government.

With hundreds of thousands of men, women, and children released from the thralldom of one of the most wasting and preying diseases that may attack the human system, humanitarian ends without measure have been served; and, with their earning power doubled, their ability to work in many cases trebled, the great crusade against the hookworm in Porto Rico constitutes one of the brightest pages in all colonial history. Here public medicine has been put to the test, and the most enthusiastic promises of the sanitarian and exponent of preventive medicine has seen his dreams come true.

A TERRIBLE PICTURE

That Porto Rico under Spain was little different from Central America today is shown by a prize-winning essay that was published at the big centennial celebration of 1897—an essay that was awarded the prize by the Spanish authorities on the island themselves. In that document the essayist declared:

"Only the laborer, the son of our fields, one of the most unfortunate beings in the world, with the pallid face, the bare foot, the fleshless body, the ragged clothing, and the feverish glance, strolls indifferently, with the darkness of ignorance in his eyes. In the market he finds for food only the rotten fish or meat, codfish covered with gangrenish splotches, and Indian rice; he that harvests the best coffee in the world, who aids in gathering into the granary the sweetest grain in nature, and drives to pasture our beautiful young beef animals cannot carry to his lips a single slice of their flesh; coffee is to him a prohibited luxury, and he can use only sugar laden with impurities."

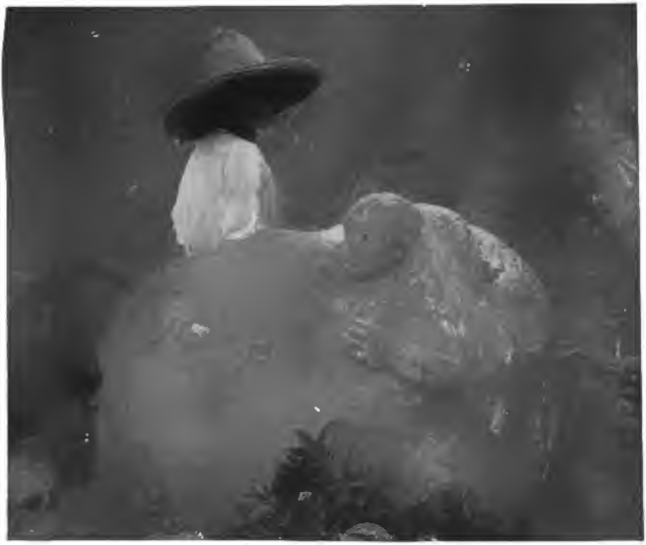


Photo from W. H. Holmes, U. S. National Museum

A REPULSIVE IDOL

This curious stone was found in a corn field a few hundred feet from the station at Xico, in Mexico. An animal figure with a human head is carved in high relief on the boulder to which it seems to be clinging. Some idea of its size can be gained from the little Mexican boy who is shown alongside it.

The picture which then fitted Porto Rico now fits Central America. The laborer of Porto Rico, who then got less than 20 cents a day for his work, was even better off than the present laborer of Guatemala, who now gets nine cents a day for his. Then, seven out of nine Porto Rican laborers were barefooted; today nine out of ten wear shoes, while in Central America six out of seven are barefooted.

Lest it seem to appear that in comparing Porto Rico with Central America the comparison is an unfair one, let Cuba be taken instead. Cuba has an area somewhat smaller than Guatemala and a population approximately equal, and yet it enjoys a foreign trade 13 times as large. It has an area one-fifth as great as that of all of the six Central American republics, including Panama, and yet its foreign commerce is three times as great as that of all six republics together.

GOOD GOVERNMENT SPELLS PROSPERITY

Jamaica, a British possession, has an area only one-twelfth as great as that of Nicaragua, and yet it has a foreign trade three times as great. One might go on with these enumerations indefinitely, the lesson of them all being that prosperity cannot exist where good government does not. On the other hand, it is equally demonstrated that poverty cannot exist in the Caribbean region where good government is found.

SCENE ON THE MAGDALENA RIVER, COLOMBIA Photo from Mrs. Harriet Chalmers Adams

The Magdalena River is the chief highway between the interior of Colombia and the sea. It is a very rapid river, and its navigation is difficult, but river steamers ply regularly as far as Honda, about 600 miles from its mouth. There navigation is interrupted by a series of rapids; but a railroad has been constructed along the banks which permits merchandise to be transported to the upper reaches of the river, which are navigable for a considerable distance. The total length of the Magdalena is about 900 miles, and its mouth is obstructed by a delta.

GUATEMALA

A trip through the countries of the Caribbean is a trip of remarkable contrasts. In some ways Guatemala is the most interesting of them all. Guatemala contains a larger proportion of pure-blooded Indians than any other of the republics.

In northern Guatemala one sees many tribes of Indians who have never felt the rude touch of an outside civilization. They are not even acquainted with Spanish, and still speak the uncorrupted tongues of their Aztec and Mayan ancestors who ruled the country before Columbus discovered America. They are an honest and cleanly race. They will not tolerate loose women among them, and in their transactions with outsiders their word is as good as old wheat in a granary.

A little illustration of this it was my good fortune to see when I was in Guatemala City with Secretary Knox. Indians from every part of the republic were compelled to go to the capital and participate in the big parade. While calling on Consul General Bucklin, a Mrs. Owen, who has spent 30 years among them, brought in two typical San Cristobal Indian girls to be photographed. One of them had a very unique set of native-wrought silver ear-rings, which I bought from her, and also a silver ring surmounted with a little spread-winged dove. Then she had another ring which I thought was a hand-carved gold one. She replied that she would not sell it, since it was not gold. Mrs. Owen assured me that she has never known one of them to misrepresent anything in order to effect a sale.

Yet it is these splendid types of people who become slaves to the Guatemalan coffee planters and are forced to work their lives away trying to pay their debts on a wage of less than nine cents a day.

WHAT AN AMERICAN CORPORATION DOES FOR THE INDIANS

It is in Guatemala that one begins properly to appreciate the great civilizing influence of a much-maligned American corporation—the United Fruit Company. That corporation has many thousands of acres of banana plantations along the lowlands of the Motagua River and extending to the Caribbean Sea. It pays its laborers a dollar in gold a day, eleven times as much as the laws of Guatemala say shall constitute a day's wage. One readily can imagine what a boon this is to poor Indians who have formerly been paid only nine cents. Yet the United Fruit Company voluntarily pays this wage, and is able to give work to every Guatemalan Indian who applies for a job.

It is the advent of such organizations as these—powerful enough to protect their own interests when disputes with the local governments arise—that spells the economic salvation of these countries and promises an honest wage to the laboring classes. I hold no brief for the United Fruit Company, but it must be said that that great corporation has done more for Central America than all other agencies combined.

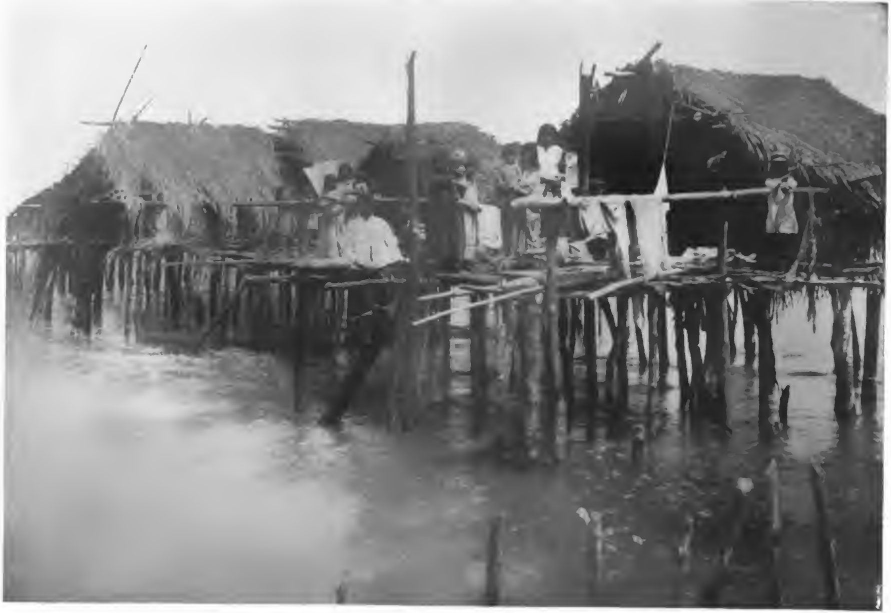
HONDURAS IS VERY UNFORTUNATE

Honduras is in a very bad way from whatever standpoint one views it. It has a smaller population now than it had a half century ago, and it has gone to wreck and ruin to such an extent that nothing but outside help can ever lift it again to a plane where growth and development are possible. And yet it is rich in natural resources almost beyond imagination.

With vast deposits of minerals of all kinds; with untold thousands of acres of the finest tropical fruit and vegetable lands in the world, and with vast areas of magnificent grazing and coffee lands. Honduras is at our very doors. It is 700 miles nearer to Chicago than that city is to San Francisco; it is closer to Washington than Denver is; it is farther from New Orleans to Chicago than it is from Puerto Barrios and Livingston to New Orleans. A stable government for Honduras, and it must become a kingdom of plenty instead of a principality of poverty!

A KINGDOM OF PLENTY

Across the border is prosperous little Salvador. It is as different from Honduras as night is from day. It has a population so dense that if ours were of



PILE DWELLINGS ON LAKE MARACAIBO Photo from Mrs. Harriet Chalmers Adams

It is to these pile dwellings that Venezuela owes its name. When Alonzo de Ojeda, the explorer, arrived on its shores in 1499, these Indian villages, built then, as now, on piles, reminded him of Venice, which is also built on piles, and so he called the country Venezuela, or "Little Venice."

Photo from Mrs. Harriet Chalmers Adams

LAKE MARACAIBO, VENEZUELA

This is a great lake, quadrangular in shape, in western Venezuela, 137 miles long and 75 miles broad. It communicates with the sea by 13 channels, each obstructed by a sandy bar, but for which the lake would be navigable for large vessels. The influence of the tides is felt in the lower part of the lake, and the water is consequently brackish, but in the upper half the water is sweet. A city and seaport, founded in 1571, of the same name stands at the entrance to the lake.

equal density we would have a population of 700 million in the continental United States; and although nearly half of the country is mountainous, the people are able to get their living out of what they produce and still have a balance of trade amounting to about $3,500,000 a year.

The Salvadorean people are different from those of any other Central American State. They have a middle class. There are thousands of little farms not much larger than a good-sized city block, and yet it is here that the real prosperity of Salvador is created.

In no other way could nearly 2 million souls find subsistence on 7,225 square miles of territory, nearly half of it mountains. Salvador has had its revolutionary troubles, too; but they have been more because of bellicose neighbors than because of internal difficulties. People who cultivate their own lands have too much at stake to start a revolution with every change of the moon.

THE HOPELESS NICARAGUANS

Nicaragua is in the same condition as Honduras. They have had revolutions there since the memory of the inhabitants runneth not to the contrary. There seems to be little hope that they will ever be able to give themselves a good government. Here one sees a thousand opportunities for the development of great wealth.

Virgin forests of all the precious woods in the category extending for miles on end; coffee lands where millions of pounds of splendid coffee might be grown; sugar lands which might yield hundreds of thousands of sacks of sugar; and yet all stand idle. Why?

Ask the American coffee growers of the Matagalpa district; ask the cotton growers of Campo Santo. The revolu-

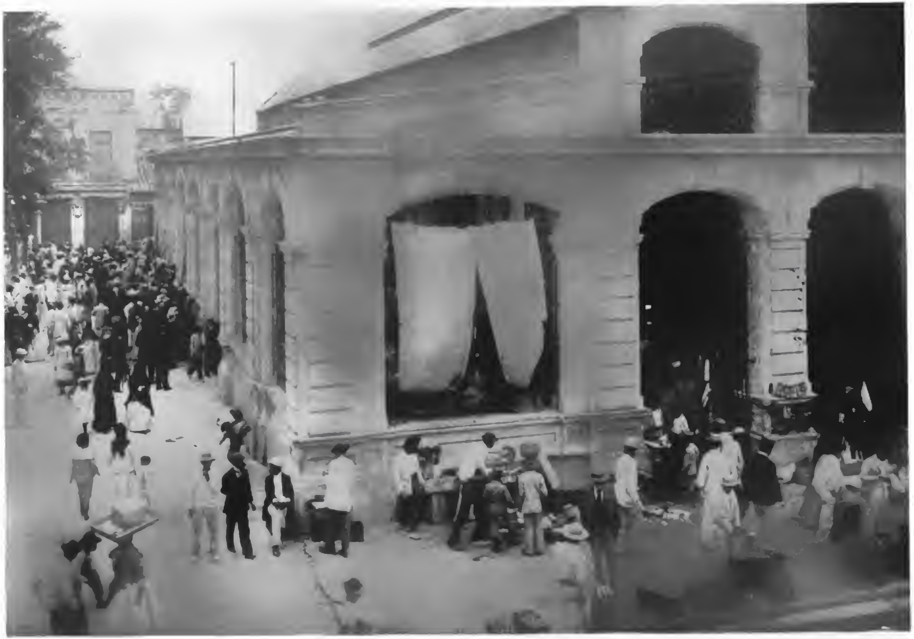


Photo from Mrs. Harriet Chalmers Adams

THE PUBLIC MARKET AT LA GUAIRA

La Guaira, as the chief port of Venezuela, has a considerable trade, being visited by about 300 vessels a year. Its chief exports are coffee, cocoa, indigo, and sugar. For nine months in the year La Guaira suffers from the heat, which is often excessive, and this, combined with the lack of sanitation, occasions malignant epidemic fevers.

Photo and copyright by The Keystone View Co.

WATCHING THE STEAMERS ENTERING PORT: LA GUAIRA, VENEZUELA

La Guaira is the chief port of Venezuela. It lies in a valley surrounded on three sides by high mountains. It is an unattractive town. The streets are narrow and badly paved, and the houses ill-built. There are, however, a few fine public buildings and some handsome churches. A winding railroad connects it with the capital—Caracas—some 23 miles distant.

tions come along and leave their coffee to spoil ungathered and their cotton to go to waste unpicked. Ask the financier from New Orleans who spent 20 years of hardships there trying to gather together a competence, and who now finds his business wrecked and in the hands of receivers.

Given good governments, then no countries on the map would afford greater opportunities for profitable investments than those of Central America. With such governments as some of them now have, all their natural wealth cannot offset the disadvantages of those governments, and an investment at 4 per cent in the United States is often to be preferred to one yielding 100 per cent in some of these countries.

A CENTRAL AMERICAN REPUBLIC WHERE THEY DO NOT HAVE REVOLUTIONS

When we come to Costa Rica things are beginning to be different, and Costa Rica does not like to be reckoned in the same class with Nicaragua, Honduras, and Guatemala. She has not had a revolution in a generation. The country is

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STREET SCENE IN CARACAS

In the towns of Venezuela the most fastidious can always be certain of the freshness of their milk. It is the custom to conduct the cow in person, often accompanied by her calf, to the door of the customer, and the operation of milking is performed in the presence of the purchaser.

so occupied with foreign interests that everybody is busy and revolutions are not to be thought of, much less started.

Panama is blest with some very fine farming and fruit lands in the region next to Costa Rica; but nearly all of the Panamans have gone down to the canal zone region for the time being. Some of the most beautiful *tierra templada* lands in America are to be found in the Chiquiri country, and when the people of the United States get acquainted with the possibilities there, some of them are going to settle in that region and make it a splendid example of the possibilities of tropical America.

It is not improbable that one of the results of the completion of the Panama Canal will be the realization by the people of the United States that its safety depends in no small degree upon the good conduct of the governments of Central America. That will mean a demand for a new order of things in these countries, which in turn will mean safe investments for American capital.

Then will dawn an era of development and expansion in Central America com-

Photo and copyright by The Keystone View Co.

A HANDSOME PLAZA IN CARACAS, VENEZUELA

The Plaza Bolivar is the center of Caracas, and contains the cathedral, the archbishop's palace, and the national library. The streets cross each other at right angles, are all numbered, lighted by electricity, and generally well paved. The city was founded in 1567, and was almost entirely destroyed by a great earthquake in 1812.

parable to that which has taken place in Porto Rico and in Cuba.

NEW YORK TO PANAMA BY RAIL. IS IT A DREAM?

Then will the Pan-American Railroad become a living reality instead of a statesman's dream. Already, in anticipation of that day, Panama is preparing to build from the canal to the Costa Rican frontier.

The gap to the Costa Rican Railroad is not a long one, and the connection through to Nicaragua would not be difficult to build. From the national railway of Nicaragua to the one now being built by the United Fruit interests from the lower part of Salvador through to a connection with the Guatemala Northern is only a short break, and then there would be actual rail connection from Panama to New York.

Of course the idea of through trains or even through cars is little more than a dream, since the roads are of varying gauges, and it will be many a year before it can even be hoped that they will all be converted to standard gauge.

Photo and copyright by The Keystone View Co.

CARACAS, VENEZUELA

This city, the capital of Venezuela, occupies a beautiful site in a narrow valley at the foot of the mountains, at a height of some 3,000 feet above the sea. Dominating the city are the twin peaks of the Silla de Caracas, which rise to the height of 8,622 feet. The climate of Caracas has been described as one of perpetual spring, with an annual mean temperature of 66 degrees; but there are very rapid changes, and the alternation of the dry and humid winds is often very unpleasant.

As it is, it is now possible to travel from Washington to the Guatemalan frontier on a standard-gauge road; but who does it once will never do it again.

The trip across the great Mexican desert is an experience not soon forgotten or desired again. With the windows of the Pullman cars down as if going through a tunnel, still the alkaline dust seeps in and makes the traveler feel that he has been in the presence of a threshing machine for 24 hours.

TWO OF THE MOST WONDERFUL RAILROADS IN THE WORLD

If Central America expects to capitalize on the building of the Panama Canal, it has no more ambitious hopes in that direction than Venezuela and Colombia. Although Colombia is still deeply aggrieved over her failure to negotiate a canal treaty with the United States, that does not prevent her from expecting much benefit from the operation of the

Photo from Mrs. Harriet Chalmers Adams

VIEW ON THE ORINOCO RIVER, VENEZUELA

This great river, which is approximately 1,500 miles long, and is supposed to have 436 tributaries, has never been properly explored, although in the days of the Spanish conquistadores it was the scene of many voyages of discovery in search of El Dorado. It flows into the sea through a delta which is 700 square miles in area, and so little above sea-level that great tracts of it are periodically flooded. The influence of the tides can be seen in April, when the water is lowest, as far up the river as Ciudad Bolivar, 373 miles from its mouth. Although it presents a magnificent waterway, the Orinoco is but little used for steamboat traffic.

big waterway. Already thousands of concessions are being issued, and Colombia, practically virgin territory so far as development is concerned, promises to be invaded by a great army of men whose mission it will be to convert her latent wealth into usable money.

Venezuela considers herself a sort of natural stopping place for travel that passes through the Panama Canal. With two of the most wonderful railroads in the world, leading from La Guaira and Porto Cabello to Caracas, one of the most charming of all the American capitals, it is certain that no place can hold out more attractions for the tourist.

On the one road the traveler must ride 23 miles to make seven, and that in itself tells a story of a wonderful mountain road, with zigzags and windings galore, with high bridges, gorges thousands of feet deep, and other touches of scenery not surpassed in its grandeur and beauty anywhere. On the other road there are 86 tunnels in less than 100 miles of railway, and it would seem that a third of the route was made up of bridges.

Caracas has a situation to be compared only to that of Mexico City. It has a climate such that no one has failed, it is said, to sleep under a blanket since the city was founded. If its climatic charms, its beauty, and the attractions of its society come to be fully appreciated, this will be one of the places to which the tourist steamers of the world will carry their passengers. Then there are millions of acres of splendid tropical farming land in Venezuela, and rich deposits of minerals and oil.

The West Indies also are getting ready for the great boom in international trade which the completion of the canal promises. The Danish government is preparing to spend millions of dollars in deepening the magnificent harbor at Charlotte Amalia, on the island of St. Thomas, expecting that here will be a favored spot for the calling of ships after the big waterway is in operation.

Lying hard by the main shipway from Europe to the canal and being a free port, St. Thomas anticipates a great boom. And it will almost certainly become the Panama-hat distributing center of the world. I have been in every country north of the Equator, and on this island I saw the biggest Panama-hat store I have ever seen. It is probably the biggest emporium of its kind in the world.

WHERE IS COLUMBUS BURIED?

Santo Domingo expects that it will get a share in the great international commerce that will move through the Panama Canal. Not only will it afford a great highway for its exports and imports, but will also constitute an important port of call for many kinds of ships.

Here one may see the house of Columbus, and if the conclusions of the priests of Santo Domingo are to be believed, his very ashes. It seems that Columbus, his brother, and his son were interred in the Cathedral. In after years it was decided to remove the ashes of the Discoverer to Havana.

When the Spaniards were fighting in the Spanish-American war they took the bones at Havana back to Spain and interred them there. It is claimed that it has since been demonstrated that those are the bones of his brother.

The Santo Domingans afterward opened up a leaden casket and in it found the inscription "Cristobal Colon, First Admiral." Other evidence substantiates the claim and was strong enough to convince Secretary Knox that the Dominicans actually do possess the real bones of Columbus.

The casket was opened for our party. There were small parts of the skull, vertebræ, ribs, and femurs remaining; but for the most part there was nothing but dust. The bones still remaining uncrumbled would fill about a quarter-peck measure.

UNCLE SAM AS A CUSTOM'S CLERK

Under the convention by which the United States is overseeing the collection of customs in Santo Domingo, remarkable results are being achieved. When the United States sent the receiver there, the customs collections in their entirety did not suffice to meet the needs of the government and the republic was a bankrupt, defaulting on its interest and having the warships of a European nation at its door.

One of the early acts of the receiver was to revise the tariff. Export duties were cut in two and import duties were lowered 14 per cent.

Under the old tariff champagne was admitted with a nominal duty and beer was heavily taxed; silks came in almost free and cotton goods bore a heavy burden; French sardines were admitted with a low duty and rice was assessed with a very heavy one. It put the burdens of taxation on the poor masses and practically exempted the rich classes.

The revised tariff reversed all this. And under an honest administration of the tariff laws 60 per cent of the reduced tariff gives the country more revenue than 100 per cent of the old tariff. The other 40 per cent goes to the liquidation of the foreign debt of the country.

Haiti does not expect much from the Panama Canal, for here is the one spot in the New World where black rules white, and to which the tourist tide will probably never flow.

Here also there have been revolutions, starting almost with each change of the moon, for a generation or more. The country is perhaps the most backward in the New World. They never plant anything. Haiti grows a considerable amount of coffee, but it grows on trees which are now the wild descendants of the trees which were planted by the French colonists.

Porto Rico feels that the completion of the canal spells new prosperity for it Plans are on foot for a magnificent tropical hotel, to be built at San Juan. Being hard by the natural route for ships between the canal and Europe, it expects to profit by the traffic as Genoa profited

Photo by Luis F. Chibas

ROAD-MAKING IN CUBA, WITH FOUR-TON ROLLER, IN THE INTERIOR OF THE ISLAND

Cuba has always been handicapped by a lack of good roads, and one of the greatest blessings of the American occupation was the initiation of an era of road-making

Photo from Frederick J. Haskin

A HAVANA BABY ENJOYING ITS MIDDAY LUNCH

This is by no means an uncommon sight in the poorer quarters of almost any Cuban town. All through the tropics and particularly among the Latin peoples the goat is a domestic animal of greater value than the cow. Its milk is preferred for infant feeding, and it needs less care and attention than the cow.

Photo from Bureau of Insular Affairs

A TOBACCO PLANTATION; LA PLATA, CAYEY, PORTO RICO

This picture shows one of the refinements of tobacco growing, the use of cheese-cloth to cover the growing plants. It has been found that tobacco, protected in this way, is much more valuable than that grown in the open. The leaf is lighter in color and weight; the texture is much finer, yielding a larger number of leaves suitable for cigar wrappers. The tobacco is also much purer and has a lesser amount of nicotine, gum, cellulose, and resin than the open grown leaf. This tent system of production is used in Cuba as well as in Porto Rico.

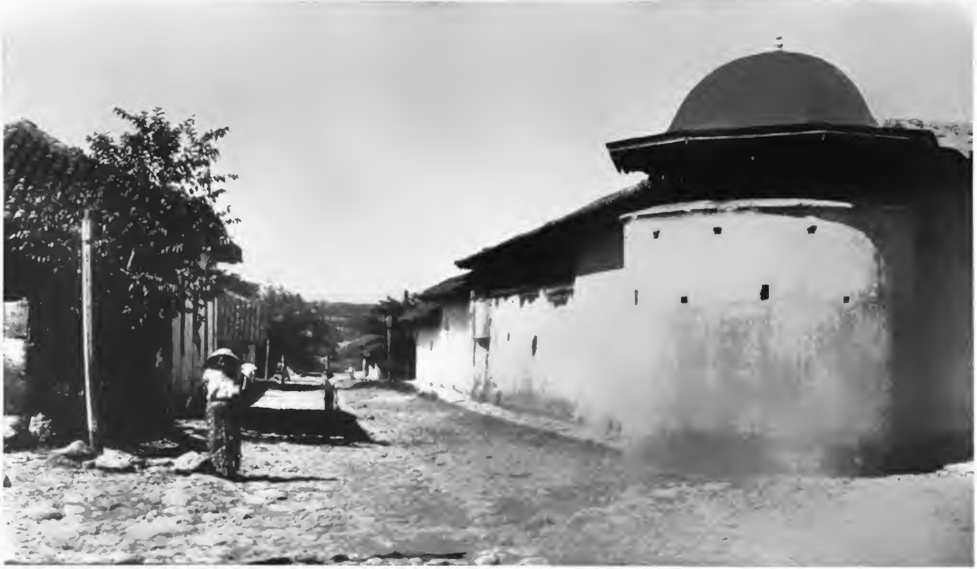


Photo by George R. King

THE BARRACKS AT LA UNION, SALVADOR

The port of La Union possesses the best harbor in San Salvador—deep, land-locked, and secure in all weather. It is the outlet for all the produce of the eastern half of the republic. The town, which stands between the harbor and the foot of the volcano of Conchagua, is a typical Central American city—ill-built, ill-paved, and ill-lighted. As usual, the most substantial buildings are the barracks, the jail, and the churches.

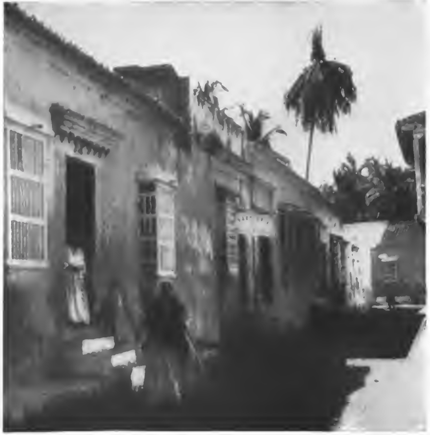


Photo by Louis Boury

CARTAGENA, COLOMBIA

Cartagena is the principal naval station of Colombia, and has the best harbor on the north coast of South America, occupying an area of about 62 square miles. Although possessed of considerable trade, the city has no modern quays, and large vessels have to discharge into lighters, as they cannot approach within a mile of the landing. There is, however, a railroad pier, some 120 feet long, which permits smaller vessels to discharge alongside. The city, with its green patios and red roofs, is very attractive to the eye, but has the reputation of being most unhealthy, especially to those unacclimated. Its climate, however, does not seem to effect the natives, of whom a large proportion are of negro descent.

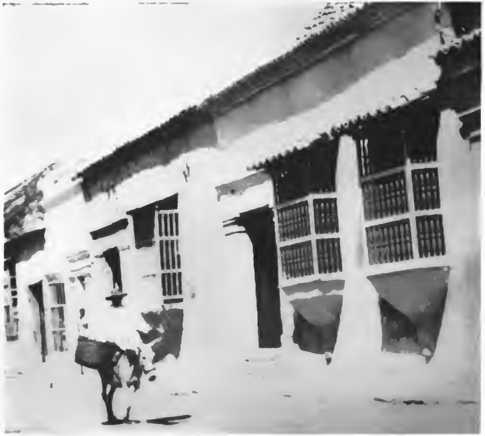


Photo by Louis Boury

CARTAGENA, COLOMBIA

Cartagena is the most important of the seaport cities of Colombia, fronting on the Caribbean. It is an ancient city, dating from 1533, and has twice been captured by pirates—once in 1585, by the famous Sir Francis Drake, who exacted a very large ransom before departing. The city was once the headquarters of the Inquisition in South America, and the building it occupied is still extant. Cartagena is an episcopal see, but its cathedral does not compare with the beautiful old Jesuit Church of San Juan de Dios, whose marble pulpit is considered the finest work of its kind in all America.

Photo by Louis Boury

CARTAGENA, COLOMBIA

The houses in Cartagena are built in the old Moorish style, originally imported from Spain. The open, tree-planted patio in the center is the focus of the family life, and on to it all the rooms of the house open. Very little adobe is used, and in the older houses the walls, of brick or stone, are often 3 feet thick. The windows and doors giving on to the street are heavily barred, so that the houses have a fortress-like appearance. The importance of the shady patio and the thick walls can be appreciated when it is realized that the mean annual temperature is no less than 82 degrees Fahrenheit.

Photo by Louis Boury

CARTAGENA, COLOMBIA

The old city of Cartagena is built on a peninsula joined to the mainland by a narrow causeway. It is inclosed by walls and defended by forts dating from the 16th century. These forts, long since dismantled, are still in a good state of preservation. The streets are generally narrow and tortuous, paved with cobble-stones, but lighted by electricity, while through some of them pass electric cars connecting the city with the suburbs of Ximani, on another island. There is an admirable water supply, due to an English company, which brings the water from Turbaco, 300 feet up in the hills, behind the town, where most of the wealthier merchants have their homes.

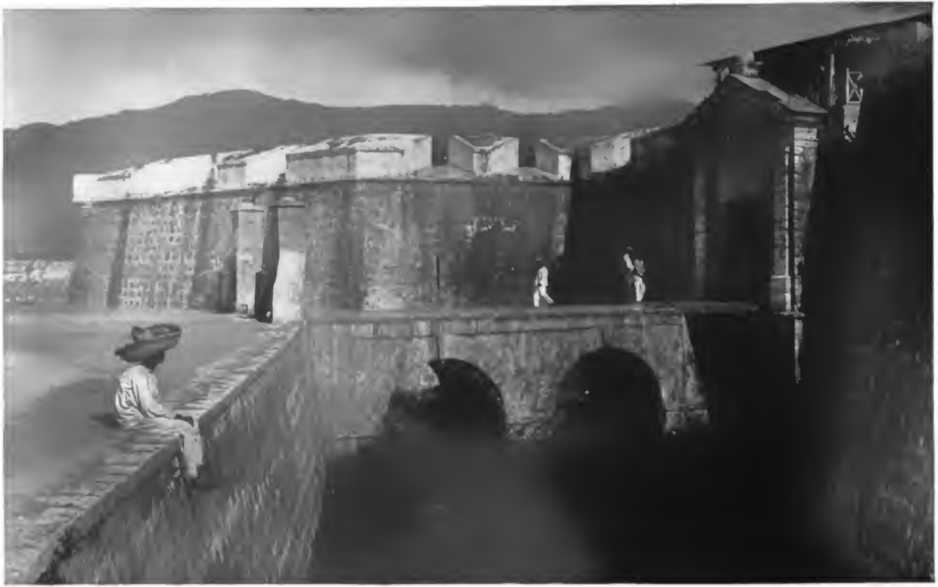


Photo by George R. King

FORT AT ACAPULCO, MEXICO

The whole of the Caribbean is dotted with towns which still preserve some of those fine buildings erected by the Spaniards in the 16th and 17th centuries, when money and time were matters of no object. As befits a great religious and military nation, the churches and the forts received the highest attention. While many of the old Spanish fortresses can be found on the Caribbean, the finest example still remaining is at Acapulco, on the Pacific coast of Mexico, which in Spanish times was a city of great importance as the only depot for the fleets which ran to and fro between Mexico and the Spanish possessions in the Far East.

by the Mediterranean traffic before the Turks took Constantinople.

Cuba also is expecting vast opportunities for development and expansion growing out of the operation of the canal. The Cubans are so enthusiastic as to propose the cutting of a canal through the island just west of Havana large enough to accommodate all the shipping that passes from the Atlantic seaboard to Panama and *vice versa*.

It is not unreasonable to assume that if the people of Middle America can secure fair and proper governmental conditions after the completion of the Panama Canal, they can do what Cuba has done in the 13 years since the first American intervention.

Since that time the number of people in the island able to read and write has increased 140 per cent. The mortality rate has been cut down from 33.68 per thousand to 12.69, and only Australia, among all the countries of the world, can make a better showing.

The balance of trade has risen from a deficit of $27,000,000 a year to a surplus of $30,000,000. The mileage of macadam roads has increased from 158 miles to 928. Some $350,000,000 has been spent since then in the rehabilitation of the country. And even then Cuba's government has not been all that it might be, nor is it at the end of its possibilities of progress. Only a bare fraction of its agricultural lands are under cultivation; only a part of its mineral wealth has been developed. It might easily be made to quadruple its foreign trade.

But assuming that Central America can only be brought up to the standard of Cuba today, its foreign trade would amount to a full billion dollars a year instead of a beggarly 65 million today. It would have 10,000 miles of railroad where it has less than 1,000 miles today. It would have 5,000 miles of macadam roads as compared with a few hundred today. It would have a population of 11,000,000 as compared with 5,600,000 today.

This and more will certainly come to Central America if good government there comes apace with a completed Panama Canal.

IMPORTANT NOTICE TO OUR READERS

OWING to the very large increase in the edition of the NATIONAL GEOGRAPHIC MAGAZINE, the capacity of our printers, who have the largest printing establishment in Washington, has been temporarily overtaxed, with the result that the magazine is many weeks late. In September, 1912, we were printing 140,000 copies, whereas the edition for January and February had leaped to 210,000 copies. The present magazine also makes a larger book.

This increased popularity of the magazine is very gratifying; however, such an extraordinary growth was beyond all calculation.

Messrs. Judd & Detweiler, Inc., who have so admirably printed the magazine for 25 years, are now building a large new plant, which will be entirely devoted to the printing of the NATIONAL GEOGRAPHIC MAGAZINE. Meanwhile, new presses are being installed in their old building, and two shifts are working night and day. Every effort is being made to catch up with the calendar, and we hope soon that the readers will receive the magazine more regularly than has been possible in the past two months. Meanwhile, the members may rest assured that the increased edition will mean an even more valuable and entertaining magazine.

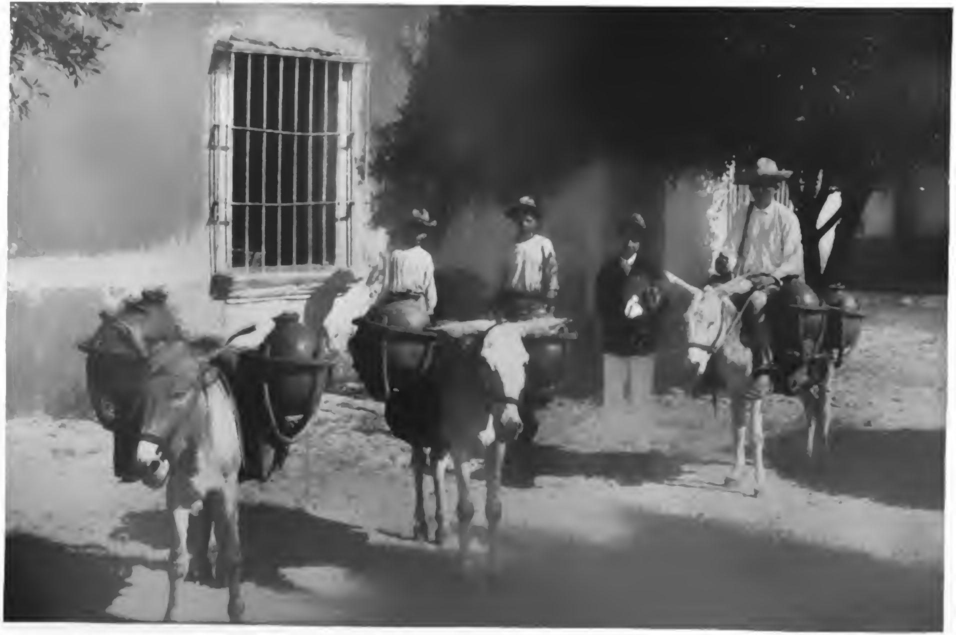


Photo by George R. King

SCENE IN SAN BLAS, MEXICO

Mexico still remains, in some respects, as primitive as when Cortez first landed on her shores. The picture shows how liquids are still transported today in the great earthenware vessels which have been used from time immemorial. Note the sandals used by the rider of the donkey on the right. San Blas, despite its open and exposed roadstead and its unhealthy climate, has a considerable trade, lumber, silver ore, and copper being exported in large quantities.

PROGRESS OF THE NATIONAL GEOGRAPHIC SOCIETY

The Reports for the Year 1912 of the Director and Editor, the Secretary, and the Treasurer

REPORT OF THE DIRECTOR AND EDITOR

THE results of the year 1912 were most gratifying in all departments of the Society's work. In the variety and extent of researches and explorations by the Society; in the number of new members added to the rolls; in the popularity, influence, and educative value of its magazine, and in the amount added to the investment fund, the year 1912 surpassed all its predecessors.

The expedition which the Society, in coöperation with Yale University, sent to Peru, under the direction of Hiram Bingham, made a careful study of the wonderful Inca city of Macchu Pichu, discovered by Mr. Bingham in 1911. The expedition stayed in this city for nearly five months, mapping it in such detail that a model can now be made of Macchu Pichu, which is one of the most extraordinary archeological finds in America during the past 50 years. The city covers the top of a high mountain, being one-half mile long and almost as wide. The buildings, are built of blocks of pure white granite, put together without cement. The publications by the Society of the results of Dr. Bingham's expedition, which also made many other new discoveries, illustrated profusely by the remarkable array of photographs that he brought back, will bring much honor and credit to the Society for its share in the work. (The April number of the Magazine will contain Dr. Bingham's report.)

The expedition to Mount Katmai, Alaska, to study volcanic conditions of the mountain and neighborhood, was also very successful. Prof. George C. Martin has completed his report, which is illustrated by a marvelous collection of photographs showing the devastation caused by the volcano. (Published elsewhere in this number.)

The expedition to the east coast of Hudson Bay, under the direction of W. E. Clyde Todd, did good work, and its biological and other studies should prove valuable acquisitions to science.

The scientific volume of the Alaska Glacier studies of 1909, 1910, and 1911 was completed by the late Prof. Ralph S. Tarr, of Cornell University, and Prof. Lawrence Martin, of the University of Wisconsin, and delivered to the Society late in the year. It will be published in 1913.

The present activity of the Society in conducting explorations is most gratifying when we realize that until very recently the Society had no funds of its own available to maintain researches.

THE NEW BUILDING OF THE SOCIETY

As the Society has no endowment, it has been the policy of the Board of Managers each year to add to the reserve fund as large an amount as possible from the annual receipts, in order that the Society might accumulate a comfortable surplus and thus be protected in times of financial stress. The wisdom of this policy is now apparent, when, owing to the immense increase in the correspondence and business of the Society, more accommodations are needed for its office force than Hubbard Memorial Hall can provide, and the erection of a new office building for the Society has become imperative. In December, 1912, the Board of Managers authorized the construction of a new building on the large property, which the Society had purchased at a cost of about $44,000, adjacent to Hubbard Memorial Hall.

The Finance Committee, which the Board charged with the duties of preparing plans, is now actively at work on the designs for the new building, which will be convenient, well-lighted, and a handsome annex to the beautiful home given to the Society by the family of its first President. It is expected that ground will be broken for the new building about April 1, and that it will be ready for occupancy before November 1, 1913. The building and equipment will cost approximately $150,000, exclusive of the land.

When the new structure is completed Hubbard Hall will be restored to the original purposes for which it was intended—a meeting-place for geographers and travelers, for the research and other committees of the Society, and for the accommodation of a useful geographical library of ready reference. The Society has several thousand standard geographical books, but owing to the crowding of its present quarters, the volumes are for the most part stored in packing-boxes.

Fourteen years ago an able-bodied man could walk off with the entire month's edition of the magazine on his back, whereas today seven freight cars are required to carry the paper for printing the current number of the magazine. The number of the magazine which contains this report would fill a book-shelf 1½ miles long. This really extraordinary development of a magazine which prints no fiction has been made possible largely because of the belief of the old and new members in the object of the Society and of the loyal support which they have given to its policy of popularizing geographical knowledge, particularly as expressed in its magazine.

During 1912 there was a uniform growth in new members and in receipts of approximately 60.5 per cent over the preceding year, the largest percentage of increase that the Society has attained during the past six years. I give below a table showing the progress of the Society in its membership, in its receipts, in its earnings, research expenditures, and investment for each of the last six years. It is there shown that the membership, the receipts, and the earnings for the year 1912 were practically four times the corresponding figures for the year 1908.

	Members.	Receipts.	Surplus after payment of all expenses of the year.	Appropriated for research.	Invested.
1912	160,565	$369,829.34	$64,564.31	$13,740.76	$50,823.55
1911	102,051	224,927.12	43,886.96	5,200.94	38,686.00
1910	74,018	168,863.43	36,872.00	8,766.00	28,096.00
1909	53,333	127,275.70	25,466.07	5,746.39	19,719.68
1908	38,698	84,083.54	16,898.00	None	16,898.00
1907	31,272	80,707.29	19,013.00	1,729.15	17,283.85
Total			$206,700.34	$35,183.24	$171,507.08

Total investments and cash of the Society (December 31, 1912)........ $177,060.00

This increased growth of the Society will provide funds for an even more valuable magazine in 1913 than the Society has yet been able to publish. Several new maps and panoramas, including another wonderful mountain panorama by Dr. Charles D. Walcott, Secretary of the Smithsonian Institution, and several colored features will appear in early numbers of the magazine. Each number of the magazine will contain splendid articles by eminent authorities, and an average of from 125 to 150 of the marvelous illustrations which have given the magazine its unique reputation for interest and instruction.

The magazine has been purchasing material in almost every part of the world and has today one of the most valuable collections of photographs in the United States. The Society has also a large equipment of machines, etc., which have been purchased during the past several years and none of which appear on the books of the organization as assets. The Society has a collection of copper plates worth many thousand dollars, also not carried as assets.

There were published by the Society during 1912 1,705,000 copies of the magazine, the average monthly edition for the year being 142,083, a gain of 48,666 per month. The average edition in 1911 was 93,417; in 1910, 68,833; in 1909, 52,833; in 1908, 41,000.

The Society is today the largest patron of the post-office in Washington, excluding the government departments. During the past year about 1,200,000 letters and 50,000 postal cards were dispatched from our office. Approximately 225,000 remittances were made to the Society, only a very small percentage of which were of a greater amount than $2. Forty-eight thousand changes in the addresses of members were made, more than 150 for each working day, and approximately 2,250 mail-bags of magazines were sent out each month.

The condition of the advertising department of the magazine is most promising for the current year. Our policy has been to limit the number of advertising pages and to refuse much advertising which we did not think desirable. For instance, advertisements of certain medicines, foods, real estate, etc., though carried by standard magazines, are not printed in the NATIONAL GEOGRAPHIC MAGAZINE.

The fact that the magazine has been built up out of membership fees and subscriptions, and has not been dependent on advertising receipts, has enabled us to be independent; furthermore, we have not had to maintain an expensive advertising staff.

Our policy is to limit the number of pages of advertising to be carried by the magazine to not more than 50 pages per month. Owing to the exceptional value of the advertising pages in the NATIONAL GEOGRAPHIC MAGAZINE, there is now beginning to be a great demand for them, and we expect shortly to command a much more remunerative price per page than has heretofore been obtainable.

The success of the Society in developing a popular magazine for the diffusion of geographic information monthly makes me believe that the Society should now undertake the publication of the ideal, or standard, books of travel. It seems to me that our aim should be to encourage a new type of geographical literature, just as we have encouraged and established a new type of geographical magazine. Our facilities for illustrating books of travel and for distributing them are unequaled. The market is flooded with books of travel every year, most of which are rubbish and not worthy of even a line of note in our periodical. They have a very small sale, because so many poor books of travel are published that the very rare good book is hidden in the mass of worthless material.

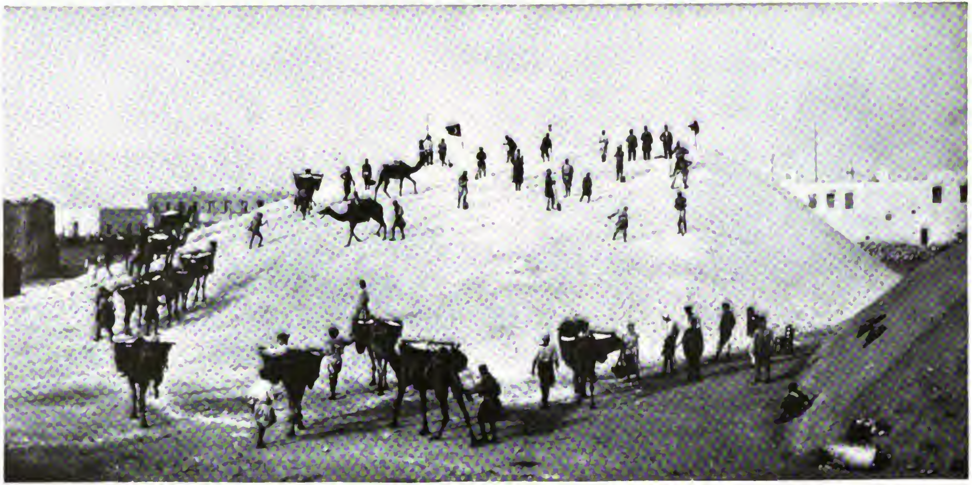
If the Society adopts the policy of printing exceptional studies of foreign peoples, such as "Farmers of Forty Centuries," by the late F. H. King, we shall undoubtedly receive applications from authors of such volumes who will want to have us undertake their publication because of the distinction that a work approved by the Society will merit from the public. We have such a tremendous field of readers that the Society ought to do all that it can to place useful geographical information before them.

Our aim is to make the magazine a source of desirable and useful geographic information to every intelligent family in the United States, and we believe that this ambition can be realized.

If the Society through its magazine can get the average man and woman in the United States to read articles like the one on "The Wonderful Canals of China," in the October (1912) number, we shall be doing an educational work which in importance cannot be overestimated.

The magazine is thus becoming one of the greatest forces in the world for a better understanding and appreciation of other peoples, and for the promotion of international good will. And in this connection I quote from an editorial in the *Boston Herald* as follows:

> "The National Geographic Society of Washington, D. C., is doing a work, through the monthly publication of its magazine, which no intelligent man or woman can afford to remain ignorant of. Geography by itself is ordinarily thought a dry subject. Geography, on the con-



A SALT HEAP AT BENGHAZI

Benghazi, the second city in Italy's new African possession, is a town with more inhabitants than Tripoli, the capital of the Tripolitana. It is the terminal point of a great caravan route between the Central Sahara and the sea. In the vicinity are great salt marshes, the produce of which is brought day by day into the city on camel back and deposited in one of the large squares. In the course of a year these salt piles grow to the height shown in the picture before being prepared for export. Benghazi also does a very considerable trade in ostrich feathers, which are brought by caravan from Central Africa. The inhabitants are Berbers, but Italians and Jews are numerous.

trary, based on geology or the vivid presentation of the great physical features of the earth on which depend all civilizations, customs, avocations, sciences, and literatures, easily becomes one of the most fascinating of studies, or even of mere cursory skits of reading.

"Strange to add, in its bearing on such affections of the heart as ardent love of country and patriotic pride in its great foreordained destinies, here is an agency the force of which cannot be overstated. Indeed, the modern innovation of hatching chickens by incubators instead of hens is simply nowhere compared with the system of hatching patriots of the stamp of William Tell by geological geography, as exemplified in the faith and works of the National Geographic Society of Washington, D. C.

"This is no wild paradox. In truth, have not the gravest historians insisted that the reason why there is no such thing as the existence of patriotic sentiment in China is solely due to the fact that the human heart is incapable of loving 400 million fellow creatures one knows nothing about? They are a pure numerical abstraction to a man. Of their lives, languages, aspirations, joys, and sorrows he is ignorant of every concrete item, unless that they all wear the national pigtail; and so, even this dangling appendage is not potent enough to bind the people together in the chords of universal love.

"Just the same used to be asserted of the United States of America. The States were too big, too broadly dispersed, too divergent in interests, for any one to be capable of loving their multitudinous populations as fellow countrymen. All this, however, at any rate in the eyes of the National Geographic Society of Washington, is now rapidly being done away with. It is getting effected through a vivid appeal to the visual imagination which is enabling us all to see, in the mind's eye, our whole country at once and as a whole. The stupendous national enterprises already completed, or about to be inaugurated, are fast annihilating all lines of geographical division, and enlisting the minds and hearts of the scattered millions in vast undertakings in which all share a common interest and common pride."

In conclusion, you will permit me to call your attention once more to the fact that, notwithstanding the wide range of geographic subjects included in the magazine, covering archeological, geological, political, and historical themes, the standard of accuracy of fact has always been maintained. It is the reputation of the magazine for its unquestioned reliability and impartiality that is largely responsible for its popularity.

The great success of the year would not have been possible without the cordial coöperation and help of the assistant editor, Mr. John Oliver La Gorce; the assistant treasurer, Mr. F. B. Eichelberger; the assistant secretary, Mr. George W. Hutchison, and all the other members of the office force, to whom grateful acknowledgment is hereby made.

Respectfully submitted,
GILBERT H. GROSVENOR,
Director and Editor.

REPORT OF THE SECRETARY

The year 1912 shows a large increase in the membership of the National Geographic Society and a general improvement in its condition and work.

The number of members December 30, 1911, was 102,051; the number added upon their own application from January 2 to December 31 was 59,161; the losses by death, by resignation, by nonpayment of dues was 5,876. There was also a net gain of 8,029 in the number of subscribers, making a net increase of 58,514 members and subscribers during the year and the total membership, including life members and subscribers on December 31, 1912, 160,565.

Fifty-five new life members were elected during the year, making the total life membership 505.

The membership is distributed throughout all the States and Territories of the Union, and includes about 3,100 in the District of Columbia and between 1,300 and 1,400 in the Philippines, Hawaii, Porto Rico, and Alaska. The membership in foreign countries is 3,550, and represents 50 different countries, including most of the European countries, Egypt, India, China, Japan, Australia, New Zealand, and the various Central and South American countries and several West Indian islands.

The membership in Canada is 1,550, in Mexico 550, in Cuba 350, in Europe 2,300, Central and South America 350.

In January, 1912, Mr. James Bryce, the British Ambassador, was elected an honorary member of the Society.

Respectfully submitted,
O. P. AUSTIN,
Secretary.

REPORT OF THE TREASURER OF THE NATIONAL GEOGRAPHIC SOCIETY

For the Fiscal Year Ending December 31, 1912

RECEIPTS

Cash, as shown by statement of December 31, 1911	$42,876.92
Dues	264,499.74
Life memberships, 55 at $50	2,750.00
Magazine subscriptions and sales	28,243.08
Lectures	7,238.96
Advertising	41,446.43
Interest on investments	3,458.85
Interest on deposit in bank	687.87
Publications	20,251.02
Sundry	1,355.39
	$412,808.26

DISBURSEMENTS

Magazine, paper, printing, articles, etc.		$167,138.89
Pound-rate postage on magazine		13,000.00
Postage on letters, etc		24,867.00
Salaries and services		54,331.90
Printing and stationery		16,036.67
Lectures		9,643.52
Hubbard Memorial Hall		1,769.53
Publications, scenes, panoramas, maps, etc		28,863.08
Research:		
Alaskan glacier expedition, 1911	$759.28	
Alaska volcano expedition	1,500.00	
Peruvian expedition, 1912	10,000.00	
Hudson Bay expedition, 1912	500.00	
Instruments, research expeditions	976.83	
Sundry	4.65	
		13,740.76
Advertising commission		2,376.33
Library		208.20
Investment account, purchase of bonds, and real-estate notes secured by first mortgage		49,961.99
Equipment:		
Furniture	$1,177.75	
Machinery	1,912.48	
		3,090.23
Sundry		4,647.69
Cash balance in the Washington Loan & Trust Company		23,132.47
		$412,808.26

ASSETS

Investments, General Account

5% notes, secured by first mortgage on real estate		$47,300.00
Bonds:		
10 $500 bonds, Capital Traction Co., 5%, at purchase price	$5,518.75	
8 $500 bonds, Washington Gas Light Co., 5%, at purchase price	4,438.75	
10 $500 bonds, Georgetown Gas Co., 5%, at purchase price	5,427.50	
4 $1,000 bonds, Potomac Electric Power Co., 5%, at purchase price	4,135.00	
		19,520.00
Real estate:		
Lot 45, square 183, at purchase price	$11,338.95	
Lot 46, square 183, at purchase price	16,145.22	
Lot 47, square 183, at purchase price	15,876.00	
		43,360.17

Investments, Life Membership Fund

5% real-estate notes secured by first mortgage	$22,000.00
Publications on hand, cost price	21,750.00
Cash in the Washington Loan & Trust Company	23,130.47
Total assets year ending December 31	$177,060.64
Total assets December 31, 1912	177,060.64
Total assets December 31, 1911	126,237.09
Increase in assets in 1912	$50,823.55

LIABILITIES

None.

Respectfully submitted.
JNO. JOY EDSON,
Treasurer.

VOL. XXIV, NO. 3 WASHINGTON MARCH, 1913

THE NATIONAL GEOGRAPHIC MAGAZINE

OYSTERS: THE WORLD'S MOST VALUABLE WATER CROP

BY HUGH M. SMITH

U. S. DEPUTY COMMISSIONER OF FISHERIES

Author of "Making the Fur Seal Abundant," "Federal Fish Farming," "Our Fish Immigrants," "America's Most Valuable Fishes," "The Pearl Fisheries of Ceylon," "King Herring," "Some Great Fishes of the Sea," "Brittany, the Land of the Sardine," etc., in the National Geographic Magazine.

OYSTERS are the most popular and most extensively eaten of all shellfish; economically, they are the most important of all cultivated water products and, with the single exception of the sea herrings, the most valuable of all aquatic animals. Zoologically considered, oysters are lamellibranchiate mollusks of the genus Ostrea.

In at least 35 countries oysters support a special fishery, and in various other countries enter into the food supply. On the shores of all the temperate and tropical oceans and seas, oysters occur in greater or less abundance; but the supply in the North Atlantic exceeds that of all the other waters combined. Not less than 150,000 men and women are engaged in the oyster industry; and the capital invested in vessels, boats, apparatus, oyster lands, and cultural establishments aggregates many million dollars.

The oyster crop of the world at the present time amounts to over 42 million bushels and is valued at nearly $25,000,000. Of this output, the share of the United States is 88 per cent of the quantity and 69 per cent of the value. Of the remaining portion, fully 65 per cent of the quantity and 50 per cent of the value belong to France.

At least 100 species are known, with a rather wide range in size, shape, habits, flavor, and food value. Some excellent species exist in the equatorial and subtropical regions, but the best occur in temperate climes. The northern limits of their habitat are the Gulf of St. Lawrence and southern Norway in the Atlantic, and Hokkaido and Puget Sound in the Pacific.

Oysters produce an immense number of young in order to compensate for the heavy mortality that occurs at all stages of growth, but particularly in the early months. It is an astonishing biological fact that in some species of oyster each sex is represented by a different individual, as in the oyster of the Atlantic coast of North America; while in other species both sexes are united in one individual—the male stage alternating with the female, as in the common oyster of the Atlantic coast of Europe.

After the oyster attains a size that is visible to the unaided eye, it is incapable of changing its position. This is in marked contrast with the newly born young, which is a free-swimming creature, floating about with tides and currents, and quite as likely to settle down on a far-distant bank or bar as to rejoin its progenitors.

Photo from Dr. Hugh M. Smith

THE OYSTER FLEET LYING OFF BALTIMORE

Baltimore is the chief point of distribution for the oysters produced in Chesapeake Bay, which is the greatest oyster ground in the world. Baltimore is also one of the great centers of the oyster canning industry. Oysters were first canned at Baltimore in 1820 by a certain Thomas Kennett, but it was not until 1850 that oyster canning became a distinct and permanent industry. Until 1900 Baltimore held the undisputed control of this industry, but since that time other canneries have been opened in the South. The expression "cove oyster," which now seems synonymous with canned oysters, was originally given to the small oysters found in the coves on the west bank of Chesapeake Bay between Baltimore and the mouth of the Potomac.

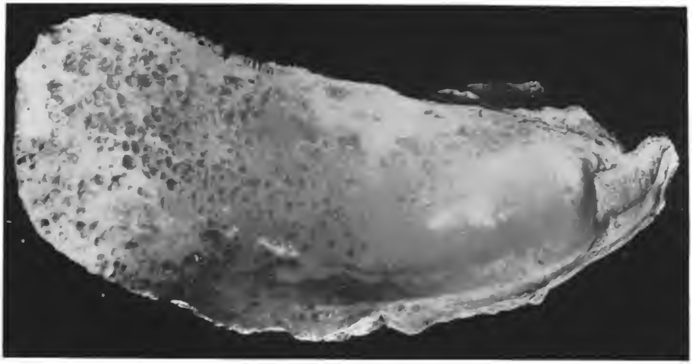


Photo from Dr. Hugh M. Smith

VERY YOUNG OYSTERS ("SPAT") ATTACHED TO THE INSIDE OF AN OYSTER SHELL WHICH HAS BEEN "PLANTED" FOR THIS PURPOSE

The planting of suitable material, such as old shells, gravel, etc., to which young oysters may attach themselves after the free-swimming stage, is an exceedingly important branch of the oyster industry, for any of the young falling on mud or sand are lost.

Of the millions of microscopic young liberated by a single full-grown oyster, only an exceedingly small percentage become attached to a suitable bottom, form a shell, and enter on a career that will terminate on the table in two to four years. When the temperature, density, tides, and currents are favorable, the young will settle on an existing bar or bed, covering the shells of the old oysters and any other hard surfaces or objects that may be present. All the young that fall on a muddy or soft sandy bottom, or on surfaces that are slimy, are lost. Oyster culture therefore aims primarily to conserve the free-swimming young, which it accomplishes by sowing clean oyster-shells or other "cultch" to which the "spat" can attach, or by collecting the young on tiles or brush raised above the bottom or suspended between surface and bottom (see pages 269 and 274).

CHINA AND ITALY CULTIVATED OYSTERS 2,000 YEARS AGO

Oysters have been under culture longer than any other shellfish and, indeed, than any other water creature. A simple type of cultivation, with the formation of artificial beds, flourished in China at a very remote period and probably antedated by some centuries the inception of oyster culture in Italy, about the year 100 B. C. With the advance of civilization and the increase in population, oysters were in greater demand and of necessity came under cultivation in all the important maritime countries of Europe, where, at the present time, fully 90 per cent of the output represents oysters that have undergone some kind of culture. In other parts of the Old World the growing of oysters by artificial means has become an important industry, while in the Western Hemisphere oyster farming has progressed to such a point that the annual crop now exceeds the total product of the rest of the world.

Oysters are thus become the most extensively cultivated of all aquatic animals, and the yearly product of the oyster farms is many times more valuable than that of all other aquicultural operations combined.

The cultivation of oysters is made necessary by the exhaustion of the natural beds; it is made possible by private ownership or control of oyster-producing bottoms; and it is greatly facilitated by

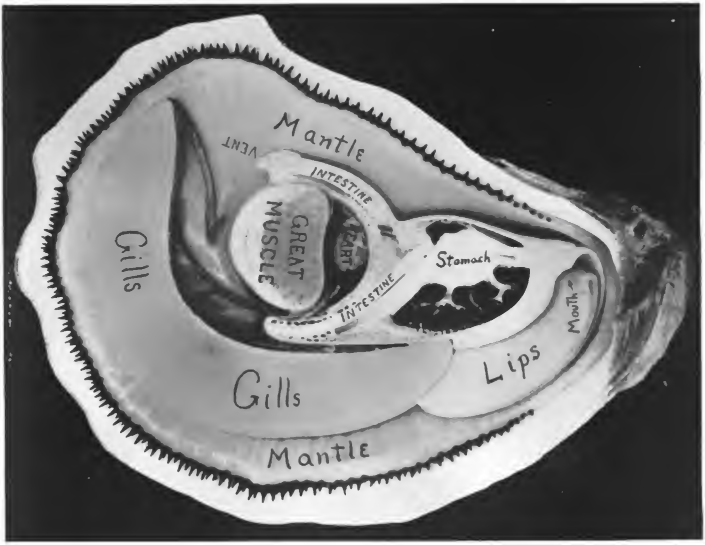


Photo from Dr. Hugh M. Smith

ANATOMY OF THE OYSTER

"It is an astonishing biological fact that in some species of oyster each sex is represented by a different individual, as in the oyster of the Atlantic coast of North America; while in other species both sexes are united in one individual—the male stage alternating with the female, as in the common oyster of the Atlantic coast of Europe" (see text, page 257).

the peculiar susceptibility of oysters to increase and improvement by artificial means.

THE OYSTER HAS MANY ENEMIES

The human animal is not the only one that looks with favor upon the edible qualities of the oyster. At every stage in its career it is attacked by a horde of dangerous enemies, some of which are most destructive after the oyster has put on its stoutest armor and would seem to be almost invulnerable. Before it becomes attached, the delicate oyster fry is extensively consumed by adult oysters and various other shellfish, as well as by fishes like the menhaden, which are able to strain their food from the water. When the oyster attains its shell, a new set of shellfish enemies, provided with drills, begin their attacks and extract the soft parts through minute holes made in valves. In some localities various snail-like mollusks do immense damage to the beds of oysters in their first year.

The oyster growers of Long Island Sound and adjacent waters suffer large losses from the inroads of starfishes, which come in from deep water and move in waves over the bottom, devouring every oyster in their path and sometimes destroying several hundred thousand bushels of marketable oysters in one State in a single season. It is remarkable that a weak creature like the common starfish should be able to prey on an animal so strongly fortified as an oyster. The starfish acts by attaching itself to the lips of the oyster-shell and exerting a steady and long-sustained traction with each of its numerous small suckers. After a time the powerful adductor muscle of the oyster becomes fatigued, the valves open, and the starfish inserts its stomach and devours the helpless oyster at leisure.

Other enemies of the grown oyster are fishes with powerful jaws armed with crushing teeth. On the Atlantic coast the most destructive fish is the black drum, a school of which may literally clean out an oyster-bed in one night. On the Pacific coast a species of stingray is the chief offender, and to stop its ravages the oyster growers have been obliged to inclose the beds by stout palisades.

Further damage is done to oysters by the encroachments of mussels, barnacles, sponges, etc., which sometimes occur so densely on the shells as to cut off food and oxygen, and thus greatly retard the growth of the oysters.

OYSTERS ARE CHEAPEST AND MOST POPULAR IN THE UNITED STATES

In any consideration of the world's oyster industry the United States necessarily receives first and most prominent mention, for there is no country in which oysters occupy a more important place. The output here is larger and more valuable than elsewhere, and the relative importance of oysters compared with the total fishery product is greater. Furthermore, among the leading oyster-producing countries the cost of oysters to the consumer is least and the per caput consumption is greatest in the United States. Additional evidence of the conspicuous position held by the oyster is seen in the facts (1) that it is taken in every coastal State except one; (2) that in 15 States it is the chief fishery product, and (3) that it is the most extensively cultivated of our aquatic animals.

The annual oyster output at this time is about 37,000,000 bushels, with a value to the producers of nearly $17,000,000. The yield has increased 70 per cent in quantity since 1880. Under the favorable conditions now prevailing, the output is becoming larger year after year in the country as a whole. The limit of production has perhaps been practically reached in certain States, but in most States the industry is capable of great expansion. In recent years the South Atlantic and Gulf States have experienced a noteworthy augmentation of yield as a result of increased appreciation of the oyster resources and increased encouragement given to oyster culture.

The seven leading oyster States at this time are Rhode Island, Connecticut, New York, New Jersey, Maryland, Virginia, and Louisiana, in each of which over a million bushels of oysters are marketed annually. Virginia is the ranking State as regards production, with over 6 million bushels, followed by Maryland, with over 5½ million bushels, and Connecticut, with about 4 million bushels. As regards value of oysters taken, Connecticut and New York lead, with over 2½ million dollars each, followed by Virginia and Maryland, with about 2¼ million dollars each. In other words, an average bushel of oysters in Connecticut and New York brings the oysterman 80 cents, while a bushel in Maryland and Virginia brings less than 40 cents.

CHESAPEAKE BAY IS THE WORLD'S GREATEST OYSTER GROUND

The body of water which produces more oysters than any other body of water in the United States or, in fact, in the whole world is Chesapeake Bay. The latest statistics of the oyster industry show the preponderating importance of the bay: an output of over 11 million bushels, valued at more than $4,250,000, or 30 per cent of the quantity and 25 per cent of the value of the entire oyster crop of the United States for 1908.

While the oyster yield of Chesapeake Bay and tributaries in all recent years has been considerably less than formerly, nevertheless the industry today is in a healthier condition than ever before. This apparently paradoxical statement is explained by the fact that whereas in earlier years a very large proportion of the product was obtained from public beds, whose depletion had already begun and whose ultimate destruction was inevitable, now an annually increasing proportion of the oyster output is taken

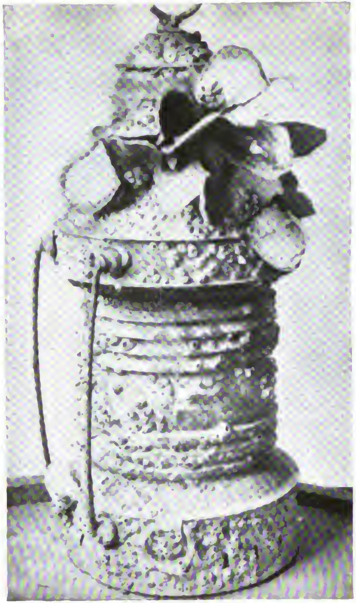


Photo from Dr. Hugh M. Smith

OYSTERS GROWING ON AN OLD LANTERN

The tendency of the oyster to attach itself to any convenient object has been made use of by the oyster culturist from time immemorial. The Romans cultivated the oyster, particularly at Lake Avernus, and the traditional method of culture is still practiced today at Lago Fusaro, near Naples.

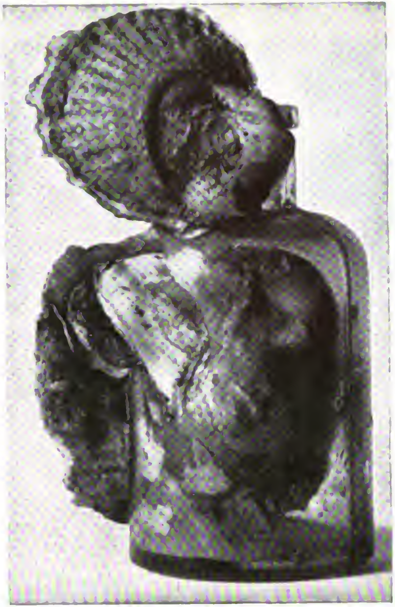


Photo from Dr. Hugh M. Smitl.

OYSTERS GROWING WITHIN AND ON A YEAST-POWDER BOTTLE

In America and England the general practice is to use old oyster-shells as cultch, but in France and Holland the spat is generally collected on concave earthenware tiles. It is necessary to detach the oysters from the tiles before they are a year old, and, as this could not be done without injury were the young directly attached to the hard tile, a coating of lime or soft mortar is used to cover the tile, and from it the [illegible] from grounds under private control and represents an actual aquicultural crop.

In Virginia about 50 per cent of the value of the State's oyster industry is contributed by grounds under cultivation, and in Maryland an increasingly large proportion is from private beds—a condition which 25 years ago would have been regarded as almost impossible, for at that time these States were firmly committed to the policy of making their oyster industry depend on public or natural beds and restrictive measures, and discouraged the general inauguration of oyster planting on public oyster grounds.

This policy was in strong contrast with that in the next most important oyster-producing region, namely, Long Island Sound, where the States of New York and Connecticut had cut loose from the old fetish of the sanctity of public oyster grounds, had leased or sold those grounds for planting purposes, and had assumed the front rank, although their natural advantages for oyster growing were much inferior to those in Chesapeake Bay.

OYSTER CULTURE IN THE UNITED STATES

The rank early attained by the United States in the oyster industry was due to the great area of the oyster-beds; but the maintenance of that rank depends on the general adoption of oyster culture as the only certain means of insuring a yearly increasing crop that will keep pace with the increasing demand.

Of the oysters marketed last year, 50 per cent came from private or cultivated grounds. Owing, however, to the improvement in the quality and shape of oysters by cultivation, the product of the private beds represented 70 per cent of the total value of the yield of market oysters. While the quantity of oysters taken from cultivated grounds in the United States is larger than in all the remainder of the world, yet the proportion of such oysters to the total output is much smaller than in any other important oyster-producing country.

Wherever the fishery is active and the demand great, the necessity for artificial measures to maintain the supply sooner or later becomes manifest. Some of the States long since ceased to place reliance on natural beds as sources of supply, and encouraged oyster culture by leasing or selling all available grounds to prospective oyster farmers, and each year other States are falling in line for progressive methods.

The American oyster industry has been greatly retarded in one of the most important regions by the failure of the States to adapt themselves to existing conditions and by their deep-seated prejudice against innovations based on modern conceptions and experience.

Nowhere in this country is there any excuse for continuing to rely on public oyster grounds as sources of supply, and the proposition to discourage or prohibit individual control of land for agricultural purposes would not be less absurd than to prevent or retard the acquisition of submerged lands for aquicultural purposes.

The prosperous condition of our oyster industry at present is directly due to the more general acceptance of more rational standards as regards oyster culture, and it is only a question of a few years when there will be unanimous recognition, as an orthodox fact, of what a short time ago would have been regarded as the rankest economic heresy, namely, that natural oyster-beds as a general proposition are to be considered nuisances, whose perpetuation delays progress and impairs the prosperity of the oyster industry.

Reduced to its simplest terms, oyster culture in the United States consists in (1) acquiring suitable submerged bottom, (2) cleaning and preparing that bottom for the growth of oysters, (3) sowing thereon shells or other material ("cultch") for the attachment and growth of the young oysters, (4) insuring the production of larval oysters by the proximity of natural or planted beds of adult oysters, (5) protecting the oyster beds from enemies, (6) transplanting as occasion requires to prevent overcrowding and to facilitate growth and fattening, and (7) culling and sorting for market.

Photo from Dr. Hugh M. Smith

OYSTER GROWING ON A PIPE

The oyster is so large and the pipe so small that at first sight it would hardly seem possible that the oyster grew from a little disc only about one-twentieth of an inch in diameter. While the young oysters are in the free-swimming stage they are even smaller, being about 1/150th part of an inch long and almost transparent.

"FLOATED" OYSTERS MAY BE DANGEROUS

A prevalent practice among oyster growers in some sections is to transfer oysters from salt water to brackish or less dense water for a short time before shipping to market, with the object of making them take on an illusive appearance of fatness by the rapid absorption of fresher water, while the more saline fluids in the tissues slowly pass out. This process, known as plumping, floating, or fattening, results in a swelling of the oysters to the full capacity of the shell, but adds nothing to their nutritive value or flavor. On the contrary, it extracts certain nutritious ingredients and replaces them with water. Chemical tests have shown that this sadly misnamed process of "fattening" deprives the oysters of 10 to 15 per cent of their food value, while increasing their weight from 10 to 20 per cent. A similar result is seen when oysters are placed in fresh water or brought into contact with melting ice after removal from the shell.

More serious, however, than the loss of nutritive properties is the danger from contamination by pathogenic bacteria when the floats are situated within the range of sewers or other sources of pollution. It is well known that oysters imbibe disease germs with their food, and such germs may be taken into the human body with their vitality unimpaired and give rise to sickness. Epidemics of typhoid fever have been definitely traced to "floated" oysters which were undoubtedly innocuous when taken from the salter water.

It will thus be seen that this feature of oyster growing is not commendable, and is necessarily prejudicial to the best interests of the industry. The growth of the practice has been due to the ignorance of the public; its continuance after its undesirable nature has frequently been shown is a sad commentary on our intelligence.

OYSTERS ON THE PACIFIC COAST

While the entire east coast of North America has but a single species of oyster, the Pacific coast has five or six native species, and has been further enriched by the one from the Atlantic.

The most abundant of the native species, found in all the Pacific States, is very small and has a strong flavor. It is never served on the half shell, but is eaten in bulk, one hundred or more oysters often being a "portion" for one person. The largest and best occur in Willapa Bay, Washington.

Photo from Dr. Hugh M. Smith

OYSTERS GROWING ON A BOOT

During the past 40 years immense quantities of Atlantic oysters have been transplanted to the Pacific coast, and a large business has sprung up which surpasses that in the natives.* It is necessary, however, to renew the supply annually, particularly in Oregon and Washington, where the water is of too low a temperature to permit the eggs of the transplanted oysters to develop. This difficulty may eventually be overcome, and an oyster fully equal to that of the Atlantic be produced, by the acclimatization from the coast of Japan of a large oyster that is able to spawn in relatively cold water. Experiments to this end have been undertaken with promising results.

In the warmer water of San Francisco Bay the conditions for oyster culture are different, and there a very extensive and peculiar kind of oyster farming has sprung up. The grounds are surrounded by stockades, principally for the purpose of protecting the beds from the inroads of strong-jawed sting-rays, which at times enter San Francisco Bay in schools, and would crush and devour large quantities of marketable oysters unless excluded by the stockades. Within the inclosures the planting, transplanting, growing, gathering, and culling are done under ideal conditions.

A large oyster, similar to our Atlantic species, grows in great abundance in the Gulf of California, and is eaten in limited quantities in the adjacent parts of

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* See NATIONAL GEOGRAPHIC MAGAZINE, June, 1907, for a fuller account of the transplanting of Eastern oysters on the Western seaboard.

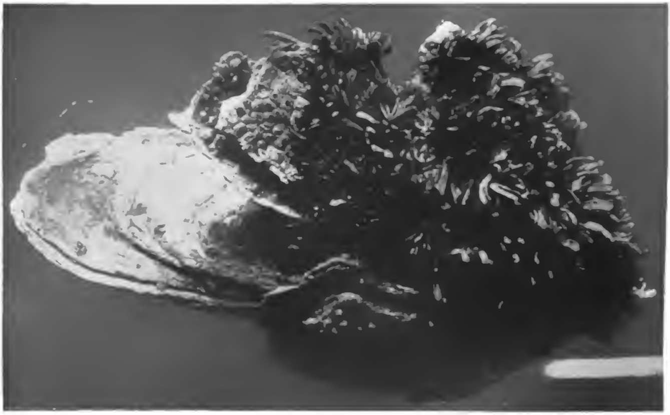


Photo from Dr. Hugh M. Smith

OYSTERS ENCUMBERED WITH A MASS OF EGGS OF THE WHELK

When the eggs hatch, the young whelks will devour young oysters by boring through the shell

Mexico. The grounds are virgin, and are capable of supporting a large industry.

HOW OUR GOVERNMENT AIDS THE OYSTER FARMERS

The Federal government, as represented by the Bureau of Fisheries, does not hatch oysters artificially and distribute them by the billion for the stocking of public and private waters as it does food fishes. A much more potent way to increase the oyster supply is the one that has been followed for many years, to the entire satisfaction of the oyster-growing communities.

This consists in practical aid to the States and coöperation with them in determining the physical and biological characters of the oyster grounds, in surveying and plotting those grounds with a view to their allotment for oyster culture, in conducting experimental and model planting operations, in recommending oyster legislation, and in giving disinterested expert advice on the various problems that arise in the development and administration of the oyster fishery.

Assistance of this kind has been rendered to every coastal State, and official requests for additional aid have of late been so numerous that the facilities of the Bureau of Fisheries have been overtaxed with respect to both funds and trained men for the work. The most recent surveys, experiments, and inquiries have been in Delaware, Maryland, Virginia, Alabama, Mississippi, Louisiana, and Texas, in several of which States the Bureau of Fisheries and the Coast and Geodetic Survey have joined forces in the accomplishment of special plans.

The beneficial results of the government's efforts in behalf of the oyster industry of the various States have been conspicuous and lasting. The recent remarkable increase of the oyster output in the Gulf States is directly attributable to those efforts.

Especially noteworthy has been the outcome of certain experimental planting operations in Louisiana. In Barataria Bay, where there had previously been no oyster industry, experimental beds laid out by experts of the Bureau

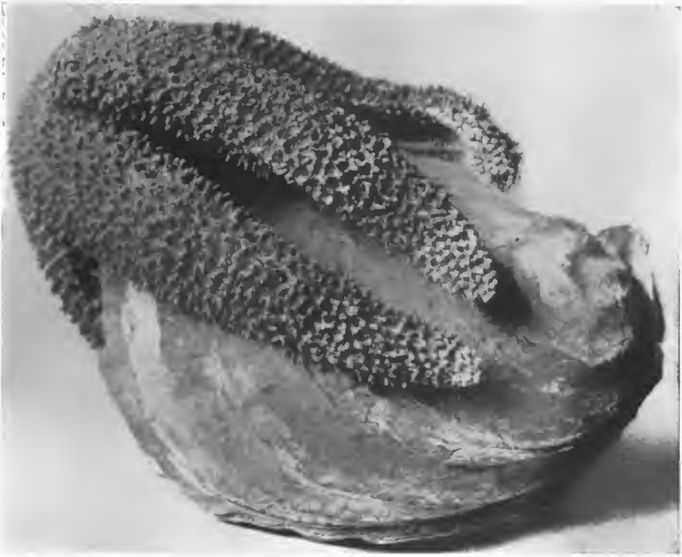


Photo from Dr. Hugh M. Smith

STARFISH ATTACKING AN OYSTER

"It is remarkable that a weak creature like the common starfish should be able to prey on an animal so strongly fortified as an oyster. The starfish acts by attaching itself to the lips of the oyster-shell and exerting a steady and long-sustained traction with each of its numerous small suckers. After a time the powerful adductor muscle of the oyster becomes fatigued, the valves open, and the starfish inserts its stomach and devours the helpless oyster at leisure" (see text, pages 260, 261).

of Fisheries yielded marketable oysters at the extraordinary rate of 1,500 to 2,000 bushels per acre in two years from the time the cultch was deposited on barren bottom. The natural consequence has been that all available oyster-growing land has been leased by the State, and a great impetus has been given to oyster culture.

The oysters thus produced on bottoms never before utilized are of high quality and meet with ready sale in New Orleans, where the "raccoon" and other oysters from the natural beds can hardly be sold at one-fourth the price.

In further pursuance of its paternal policy of promoting the oyster industry, the Bureau of Fisheries has sought to make known to fishermen, State officials, and legislatures the methods and conditions of oyster fishing and oyster culture in all parts of the world. To this end inquiries have been made in all foreign countries having important oyster resources. Special reports thereon have been issued and distributed broadcast, and, so far as its powers and facilities have permitted, the government has applied the knowledge gained abroad and at home to the particular requirements of the individual States in pointing out the way for the most successful utilization of the oyster grounds.

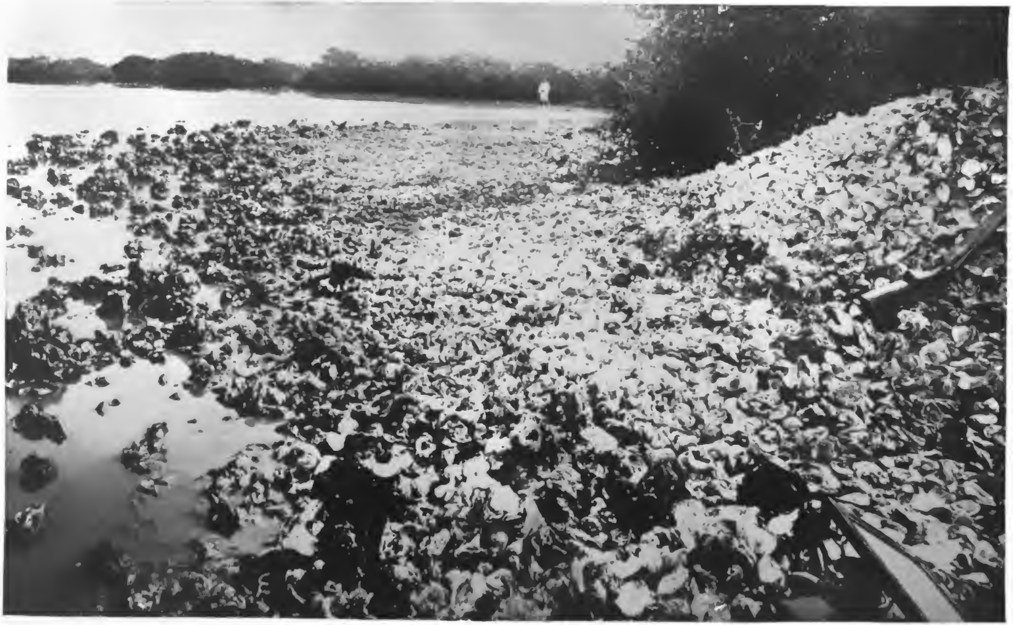


Photo from Dr. Hugh M. Smith

A NATURAL OYSTER REEF, MOUTH OF THE YAQUI RIVER, GULF OF CALIFORNIA, SHOWING DENSE GROWTH OF MISSHAPEN OYSTERS

THE FRENCH OYSTER INDUSTRY

France, which is the only rival of the United States in the oyster industry, has the distinction of maintaining the most perfect and thorough system of oyster culture in the world, although the methods pursued are not adapted to conditions in the United States or even in some countries contiguous to France.

The native oyster of France is the same species that occurs in England, Holland, and other countries of northwestern Europe. There is another species, however, which has been introduced into France and elsewhere, and has become very important on account of its hardiness, prolificness, and rapid growth; this is the Portuguese oyster, which in spawning habits and other characters is related to the American oyster, but is inferior in quality.

Oysters are cultivated along the entire coast of France.

For the handling of the native oysters the great centers of the industry are Cancale, on the north coast, and the districts of Auray, Sables-d'Olonne, Ile de Ré, Ile d'Oléron, Marennes, and Arcachon, on the Bay of Biscay. Cultivation of the Portuguese oyster is most extensive in the last four of the localities just mentioned, and, in addition, at Rochelle and Rochefort.

The number of oyster-cultural establishments in some sections is so large as to suggest that practically the entire shore-line must be occupied by parcs, claires, and viviers, as the various enclosures are called. Thus in the Marennes district there were in 1907 over 11,300 independent establishments for growing the native oysters and 5,400 for the Portuguese oysters. According to 1907 statistics, issued by the French government, 21,900 oyster farms, with a superficial area of 6,860 hectares, were devoted to the growing of the indigenous species, and 20,500 others, having an area of 5,150 hectares, were concerned with the introduced Portuguese oyster.

Oyster culture in France is of comparatively recent origin. Up to the middle of the last century the natural oyster banks were, like those of the Chesapeake, deemed inexhaustible, and dredging operations thereon were practically unrestricted. Then the government awoke to the gravity of the situation, and by stringent regulations endeavored to save the few remaining oysters.

The leading advocate and exponent of the possibilities of oyster culture was Professor Coste, who, after investigation and successful experimentation, made a report which embodied a proposition to restore the oyster banks of the entire coast. Obtaining a government grant through the interest of Napoleon III, Coste began extensive experiments, but was unfortunate in his choice of sites, met with unfavorable weather conditions, and failed in his entire undertaking, and he died blind, in disgrace, and regarded as a charlatan. Nevertheless, Coste's work was of the utmost importance, and it was his pioneer efforts that were directly responsible for the present advanced status of the French oyster industry.

Oyster culture in France has several distinct phases or branches in which the culturists specialize. The tidal oscillation leaves extensive flats exposed or nearly exposed twice daily, and this greatly facilitates the various procedures, the work being done in a horizontal plane, whereas in Italy and other countries where the tidal movement is slight the cultural operations are conducted under water and in a vertical plane.

The first essential step in the French method is to arrange on the shores, between high and low water, series of earthen tiles or wooden trays coated with lime cement, on which the floating oyster fry are collected. When the young have reached the size of a finger nail, usually by October, they are detached from the collectors by means of a short knife, the plaster being easily separated from the tile or wood. This work is done by women, who become very skillful in handling the thin-shelled seed oysters, of which as many as 20,000 or more may be detached by a woman in a day.

The young are then placed in wire gauze baskets and transferred to enclosed ponds or parcs, where growth may take place without danger from nat-

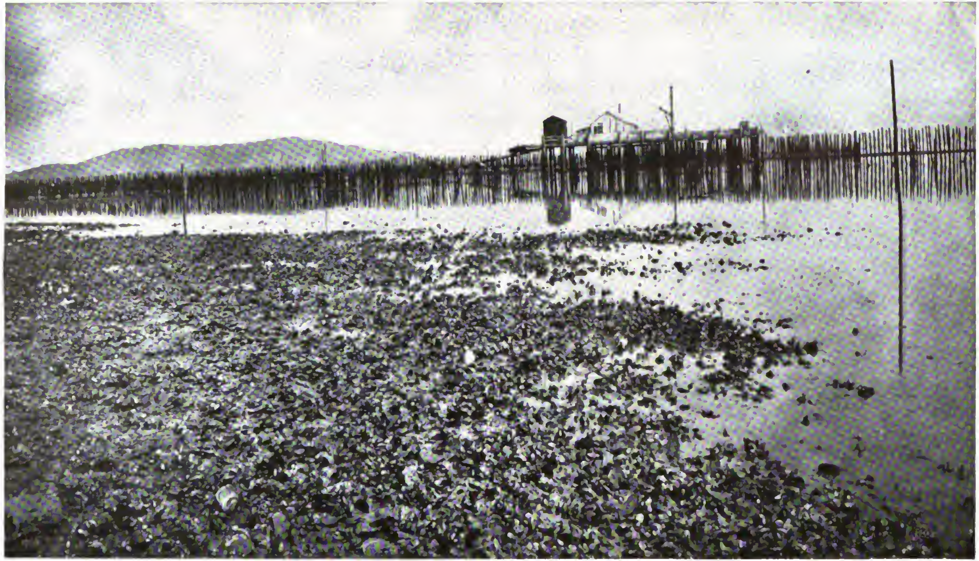


Photo from Dr. Hugh M. Smith

EXPOSED BED OF TRANSPLANTED EASTERN OYSTERS IN SAN FRANCISCO BAY

"The most abundant of the native species, found in all the Pacific States, is very small and has a strong flavor. It is never served on the half shell, but is eaten in bulk, 100 or more oysters often being a 'portion' for one person. . . . During the past 40 years immense quantities of Atlantic oysters have been transplanted to the Pacific coast, and a large business has sprung up which surpasses that in the natives" (see text, pages 264 and 265).

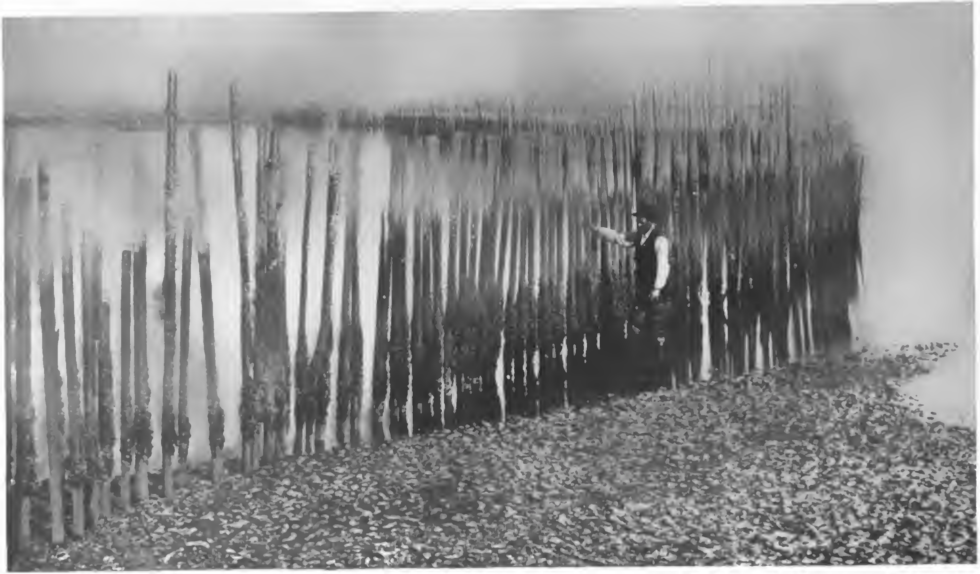


Photo from Dr. Hugh M. Smith

AN OYSTER STOCKADE IN SAN FRANCISCO BAY

"The grounds are surrounded by stockades, principally for the purpose of protecting the beds from the inroads of strong-jawed sting-rays, which at times enter San Francisco Bay in schools, and would crush and devour large quantities of marketable oysters unless excluded by the stockades. Within the inclosures the planting, transplanting, growing, gathering, and culling are done under ideal conditions" (see text, page 265).

THE OYSTER FLEET AT CANCALE, FRANCE

Cancale is situated in Brittany, not far from St. Malo. During the summer months it is frequented for sea bathing; but the wealth of the little town depends upon its oysters, for which it is famous.

ural enemies or from suffocation by mud, sand, or silt. For two to three years the oysters are thus protected, requiring frequent overhauling, thinning out, and transfer to other parcs or baskets as their size increases, this part of the work also being done by women, clad in short skirts and having heavy, square shoes on their bare feet. Another phase of cultivation is the placing of the oysters, now of marketable size, in special enclosures or claires where there is an abundance of food, so that they may become fat and plump before sale and also acquire the condition of greenness that the trade requires.

Green oysters in America are often regarded as diseased or unwholesome, and our oyster-growers strive to prevent their occurrence; but green oysters in France are in greatest demand. Marennes has long been celebrated for its oysters of a green or bluish-green color, and special efforts are there put forth to make the oysters take on the maximum intensity of color in the shortest time. The claires at Marennes swarm with the minute plants, whose color is imparted to the gills and mantle when the oysters consume them in excessive quantities. Marennes oysters command the highest price in the market because of their exquisite and inimitable flavor, which connoisseurs say is dependent on their green color.

French oyster-growers in 1907 produced upwards of 1,450,000,000 oysters, having a market value of 3¼ million dollars. In addition, there was a small product taken from bottoms laid bare at low tide, which were not under cultivation, and from deep-water public grounds. Over 22,000 men, women, and children were engaged in gathering such oysters, and their aggregate take was about 175 million oysters, for which they received less than one-tenth of a cent apiece, whereas the cultivated oysters brought nearly three times as much.

WIRE-GAUZE TRAYS FOR REARING OYSTERS: BELGIUM

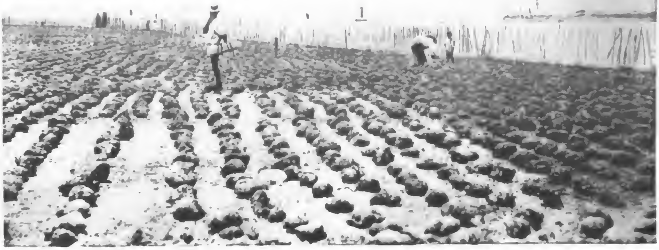
"The young are then placed in wire gauze baskets and transferred to inclosed ponds or parcs, where growth may take place without danger from natural enemies or from suffocation by mud, sand, or silt. For two to three years the oysters are thus protected, requiring frequent overhauling, thinning out, and transfer to other parcs or baskets as their size increases, this part of the work also being done by women, clad in short skirts and having heavy, square shoes on their bare feet" (see text, pages 269, 272).

ENGLAND'S ANCIENT OYSTER INDUSTRY

As early as the year 50 B. C. the fame of the British oyster had extended as far as Rome, and Sallust seems to have been more impressed by the oyster than by any other feature of the country, for he wrote: "The poor Britons—there is some good in them after all—they produce an oyster." In 80 A. D. oysters were exported from the Thames estuary to Rome, and ever since that time England has had an oyster industry of respectable proportions, although for many years the supply has been inadequate to fill London's gigantic maw, and importations from the United States, Holland, and France have been necessary.

In both quantity and quality the British product has been noteworthy from early times, and while the natural oyster grounds have been greatly depleted by excessive dredging the quality of the yield has not only been maintained, but has probably been increased by cultivation. To augment the supply of native oysters, seed is brought from America, France, Holland, and other European countries, and after being transplanted for variable periods is placed on the local market.

It is noteworthy that American oysters deteriorate when taken to England and placed on the grounds to grow and fatten; they grow rapidly, but the flavor becomes metallic and their creamy white color turns to leaden gray; furthermore, they will not reproduce. French seed oysters, on the other hand, when transplanted for three years in the English estuaries, take on the shape and flavor of the "natives," and are annually sold as such at great financial profit to growers and dealers.



OYSTER CULTURE IN FORMOSA

The soft muddy bottom all along the coast renders the cultivation of oysters a difficult matter. To obviate this natural disadvantage stones have to be laid in regular rows, to which the young oysters can attach themselves.

BIRTHPLACE OF OYSTER CULTURE

Although Italy was the birthplace of modern oyster culture in Europe and in early times had a large oyster trade, at present the oyster is not of great importance. Interest in the Italian oyster comes from its historic associations and the peculiar methods of culture which have been practiced with little change for 2,000 years.

The cardinal feature of oyster culture here is the keeping of oysters suspended between the bottom and the surface. To this end the spat is collected on bundles of twigs hanging from ropes stretched between the stakes at the corners of the squares; the brush, with the oysters attached, is woven into huge ropes, 10 to 20 feet long, which when suspended utilize the entire volume of water, and the oysters that become detached and the full-grown ones are placed for final growth, fattening, and storage in suspended baskets. It is reported that on a rope 14 feet long about 2,000 marketable oysters may be reared.

OYSTERS IN OTHER EUROPEAN COUNTRIES

Holland has a rather extensive industry, which ranks after that of France among the continental countries. The natural oyster grounds were practically wiped out by overdredging, and the institution of artificial measures has been so wisely undertaken by both government and private citizens that the Dutch have come to be regarded as the most successful administrators of the oyster industry. Efforts to restore the depleted grounds in the Zuyder Zee have been futile, and the industry now centers in the Schelde estuary, in Zeeland. The bottoms suitable for oyster culture have been carefully surveyed and plotted, and the government receives a large revenue from their lease. Zeeland oysters are in great demand in Holland, and are also shipped to England and other countries

LOW TIDE ON A JAPANESE OYSTER FARM

"Owing to a rise and fall of the tide of from 10 to 15 feet, an immense area of bottom suitable for oyster growing is exposed twice daily, and the cultural operations are thus conducted under conditions that do not exist in America or various other countries" (see p. 281).

for immediate consumption or for transplanting.

The oyster grounds of Germany are restricted to a small section of the coast of the North Sea near the Danish frontier. The banks have for three centuries been the property of the Crown, and are leased for terms of years. The government exercises strict supervision, to prevent the depletion of the natural beds and at the same time to induce the maximum production therefrom.

The oyster industry of Belgium centers at Ostend, where claires or reservoirs for fattening oysters have been in constant use for more than a century. The Belgium oysters are highly esteemed for their flavor, and Ostend is one of the great oyster depots of Europe. The physical conditions on the Belgium coast are not favorable for general oyster culture, and the industry consists for the most part in fattening and conditioning oysters from other countries. Foreign oysters transplanted in the Ostend reservoirs for a short time acquire a new flavor, and are then sold at home and abroad as "Ostends."

Denmark has an interesting oyster industry, restricted to the Limfjord, an irregular arm of the sea that extends entirely across Jutland. The oysters are the property of the Crown, and the privilege of taking them is now sold to the highest bidder, who enjoys a monopoly, with restrictions imposed by the government fixing the annual output and the maximum price that may be charged. The Limfjord oysters are nearly circular in outline and have large, plump meat of excellent flavor. No form of cultivation has ever been applied, and the supply is maintained by limiting the production. The oysters are gathered by means of steam vessels, using dredges, six of which are hauled simultaneously.

Photo from Dr. Hugh M. Smith

AN OYSTER FARM IN THE INLAND SEA: JAPAN

"The individual Japanese oyster farms are of comparatively small size and are separated from one another by bamboo fences or hedges. When viewed from a distance at low tide, the exposed bottom and the innumerable upright pieces of regularly arranged bamboo strongly suggest an agricultural rather than an aquicultural crop" (see text, page 281).

INSPECTING A JAPANESE OYSTER CROP

The great rise and fall of the tides in Japan is of considerable advantage to the oyster farmer, enabling him to keep his crop under direct observation during the entire period of growth.

IN THE SOUTHERN HEMISPHERE

The oyster resources of the lands south of the Equator are comparatively unimportant. In South America and South Africa efforts at cultivation are under way, but the most promising field is Australia. The oyster industry has attained some proportions in all the Australian States, but New South Wales surpasses all the others combined. Under a system of leases, several thousand oyster planters have been granted littoral and deep-water grounds, and the foreshores already taken up are nearly 400 miles in length. The oysters grown under the peculiar conditions prevailing are of excellent quality and have an average value to the producer of more than $3 a bushel.

JAPAN'S CURIOUS METHODS OF CULTURE

The oyster industry of Japan is not of great importance in itself, the aggregate output being valued at less than a quarter of a million dollars; but it is of interest because of the cultural methods adopted and the possibility of establishing and cultivating Japanese oysters on the Pacific coast of the United States.

Oysters of several species are widely distributed in Japan, but the business of growing and marketing oysters attains its greatest development in the famous Inland Sea, near the large city of Hiroshima. At least as early as 1720, and probably much earlier, the growing of oysters by artificial means was understood and practiced there, and long before the descendants of Mayflower pilgrims had realized the desirability of and the necessity for oyster culture, the Japanese had grasped the situation and made provision for an enlightened administration and utilization of oyster grounds, such as some American States have not yet come to appreciate.

The Japanese are so original in their aquicultural practices that their peculiar and effective style of oyster farming need occasion no surprise. Some experts have pronounced their methods the simplest and most practicable of all, and

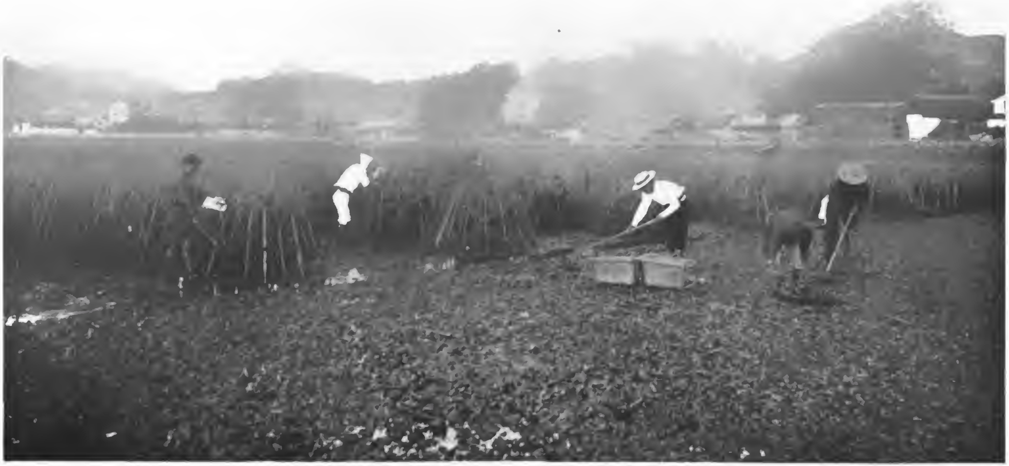
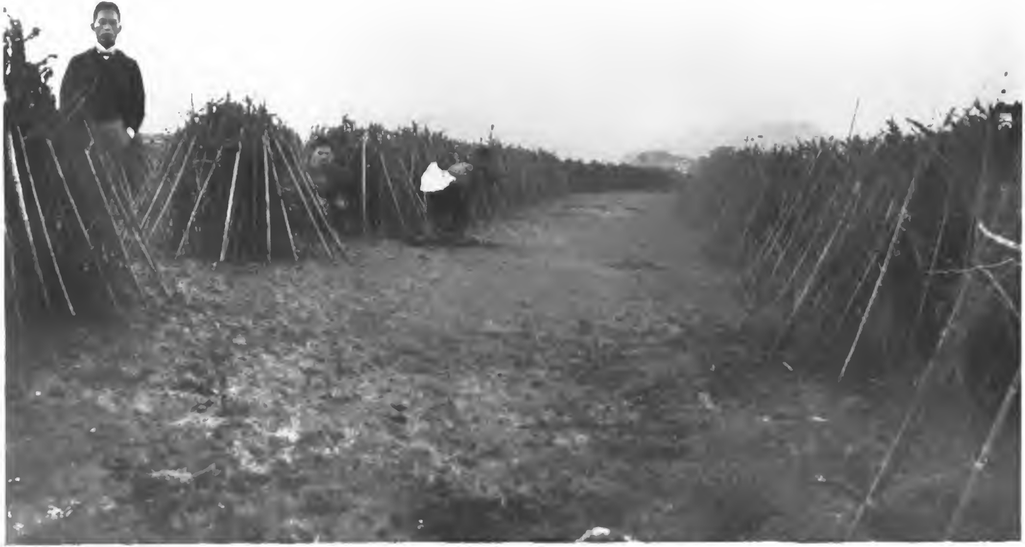


Photo from Dr. Hugh M. Smith

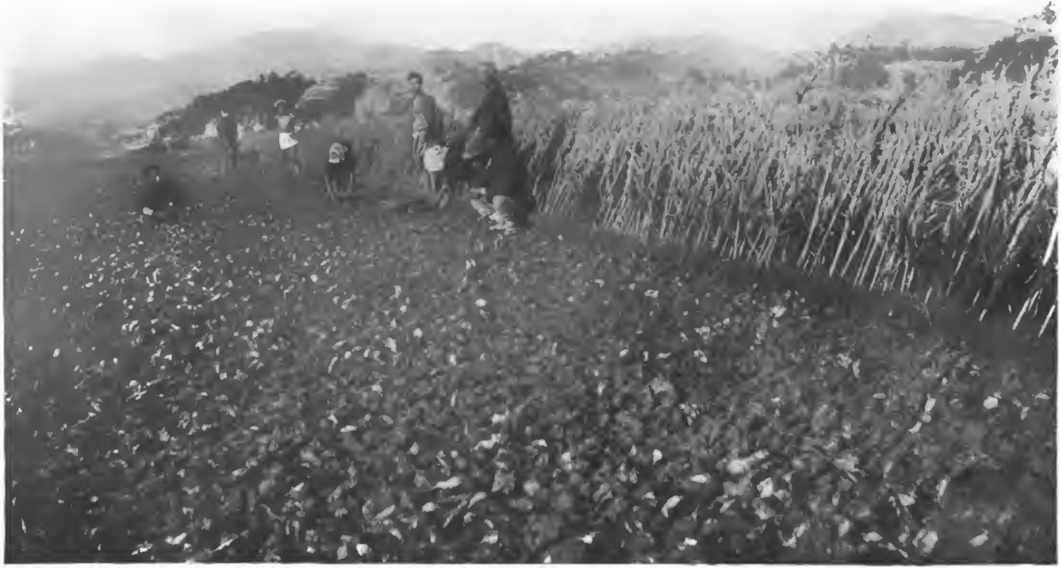
LOW TIDE IN A JAPANESE OYSTER PARK : INLAND SEA

"The distinctive feature of Japanese oyster culture is that the very young oysters are not allowed to settle on shells or other forms of cultch commercially employed in America, but are collected on bamboo stalks to which the branches and leaves are attached" (see text, page 281).



WHAT A JAPANESE OYSTER FARM LOOKS LIKE

This is a general view of a Japanese oyster park near Nihojima, Inland Sea. The piles of bamboo brush have been newly arranged for the beginning of a new season's work. At high tide this ground is submerged to a depth of 15 feet



GATHERING OYSTERS IN A JAPANESE OYSTER PARK

"Prior to the spawning season, each oyster grower sets out an immense number of prepared bamboo stalks; these are thrust deeply into the soft bottom, and are arranged in definite lines or groups so as to intercept the floating spat. After remaining attached to the bamboo brush for one to two years, the oysters are planted on prepared bottoms, where growth and fattening are completed. The oysters are marketed when two to three years old" (see text, page 281).

it behooves western countries to become acquainted with those methods even if there is no opportunity for their adoption in their entirety.

Owing to a rise and fall of the tide of from 10 to 15 feet, an immense area of bottom suitable for oyster growing is exposed twice daily, and the cultural operations are thus conducted under conditions that do not exist in America or various other countries.

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The individual Japanese oyster farms are of comparatively small size and are separated from one another by bamboo fences or hedges. When viewed from a distance at low tide, the exposed bottom and the innumerable upright pieces of regularly arranged bamboo strongly suggest an agricultural rather than an aquicultural crop.

GREECE AND MONTENEGRO

By George Higgins Moses

U. S. Minister to Greece and Montenegro, 1909–1912

OF THE four allied Balkan States who have made history so rapidly in the past few months, two—Bulgaria and Servia—are contiguous; and two—Greece and Montenegro—are isolated; isolated not only from each other and from their allies, but isolated practically from the rest of the world.

Like a clenched hand thrust down from the sturdy arm of the Balkan Peninsula, Greece, blocked, hitherto, from direct communication with that portion of the world which its people so curiously insist upon calling "Europe," has made the sea its highway from classic days; while Montenegro, perched in the rocky fastnesses of grim Cernagora, both defies and invites invasion with its magnificent system of highways so delightfully easy of passage in time of peace and so superlatively simple of defense in time of war.

Behind the stern barrier of the Loveen, towering 6,000 feet above the smiling waters of the Bocche di Cattaro, and crowned with the simple tomb of Peter II, the Montenegrin saint and lawgiver, who begged to be laid there that his spirit might survey the land he loved so well, dwell the old Lion of Montenegro and his people—he the last of the patriarchs in this modern world and they a race of warriors whose origins lie back in those misty days ere the first faint swirl of the never-ceasing flood of Slavic blood had made its way southward to sweep across the valleys and the plains from the Black Sea to the Adriatic.

WHY THE MONTENEGRIN WEARS A BLACK HAT BAND

Thither, upon the final overthrow of the ancient glory of the Serb upon the fatal field of Kossovo—in memory of which to this day the Montenegrin's cap is banded with a rim of black—thither retreated a handful of valiant souls to seek asylum with the Voivode of the Zeta. A few years later, abandoned by their ruler—who preferred a life of ease at Venice—they turned to their bishop, made him also their prince, and with him retreated still deeper into the hills and there set up that long line of the Vladikas which did not end until well into the last century.

There for 500 years they have maintained freedom, which "of old has sat upon the heights"; and, with sufferings indescribable, with courage illimitable, won from the great English apostle of Balkan freedom those words of undying praise, in which he gave it as his "deliberate opinion" that "the traditions of Montenegro exceed in glory those of Marathon and Thermopylæ and all the war traditions of the world"; and inspired in Tennyson what he regarded as the finest of his sonnets, inscribed to the

". . . smallest among peoples! rough rock-throne
Of freedom! warriors beating back the swarm
Of Turkish Islam for 500 years,
Great Cernagora! never since thine own
Black ridges drew the cloud and broke the storm
Has breathed a race of mightier mountaineers."

Ascending the marvelous zigzag road which leads up from Cattaro, one approaches the stern and gloomy defile which forms the portal to this historic stronghold of freedom in the Balkans.

A WONDERFUL ROAD

Splendid engineering is this road. Built for post and military uses, it clings to the face of the sheer rock and weaves back and forth in a multitude of "hairpin curves" which the chauffeurs of the post automobile treat with that contempt which familiarity alone can breed.

Up and ever up, one goes. Below stand forth the dusky cliffs, which jut into the southern fiord; nestling beneath them, and hemmed in with the massive battlements of those giants of an earlier day who stretched out the lion of St. Mark's from the Lido to the Bosporus, lies Cattaro—Italian in appearance, Austrian in allegiance, but Serb in feeling, its heart ever in the Highlands. Beyond smiles the Adriatic, and above tower the gaunt gray rocks, against which the road seems a veritable ladder laid upon a wall.

Threading at last a narrow defile, whose walls are pierced with caves where lurk the fables of the mountaineers, and crossing a pass too often swathed in clouds, one turns a corner and comes face to face with the ancient realm of the Vladikas.

The smile of the soft blue sea lies behind, and before stretches a wild, turbulent ocean of rock, rising and sinking in angry gray waves flecked with white, which seem to leap and rage and battle together like a sea lashed by a storm. Stones, rocks, and crags, nothing else; not a tree, not a blade of grass; scarcely even a tuft of brushwood to relieve the dreary scene of desolation.

At the creation, so runs the Montenegrin legend, an angel was sent forth to pick up the superfluous stones on the earth's surface. He placed them in a bag, which burst as he was flying over Cernagora—and certainly the landscape bears out the tale.

And yet the scene cannot be said to lack charm—the charm of majesty always to be found among the hills. And while Cernagora at first sight—gaunt, gray, and drear, an arid wilderness of bare rock—tells in one blow of the sufferings of centuries, pity does not long endure; it passes almost at once to praise for a people who have preferred liberty in this desolation to slavery in fat lands.

THE CRADLE OF THE ROYAL HOUSE

From the Austrian border to Cetinje one encounters but one village, Niegush, nestling in a little cleft in the hills and claiming attention as the cradle of the Petrovich dynasty, which for more than two centuries has ruled the destinies of the land. Here was born not only Danilo I, progenitor of the line, but most of his successors, including the present king, whose tiny villa is the show-place of the town.

Founded more than four hundred years ago by a band of refugees from the Herzegovina, Niegush cherishes the curious legend that one of its sons, wandering even farther afield, found himself one day in Abyssinia, where he became possessed of power and transmitted to his successors the title of Negus, in memory of his Montenegrin birthplace.

Here we halt for the customs examination—a formality which is soon over, even for those who do not possess a

Photo from Katrice Nicolson

A MONTENEGRIN IN THE DOORWAY OF HIS HOME

diplomatic *laisser passer*—and after refreshing ourselves with a coffee at the Grand Hotel, which the town possesses in common with every other in Europe, we begin the ascent from the pocket of Niegush, and an hour's climbing brings us to the top of the pass, and we behold Cetinje.

WHERE THE CONQUERING TURK HAS NEVER TROD

The distance as the crow flies is short; but the winding road multiplies the miles, and we have ample opportunity to survey the tiny capital which boasts itself—albeit somewhat inaccurately — that its

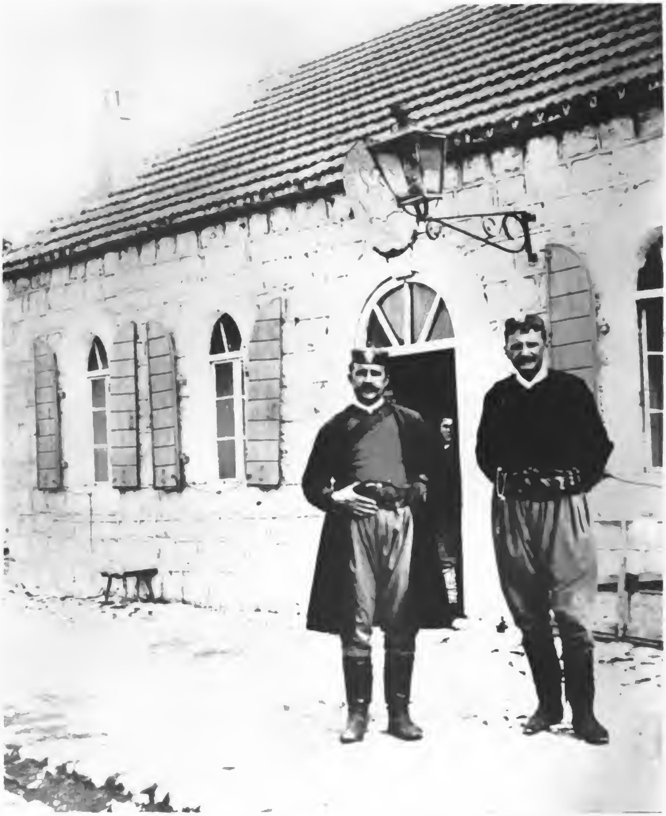


Photo from Katrice Nicolson

TWO MONTENEGRIN OFFICERS IN NATIONAL COSTUME

Note the double eagle over the door bearing the royal cipher (N. I.) of Nicholas I

Photo from Katrice Nicolson

SOME OF THE MONTENEGRIN VETERANS OF 1860

streets alone of all the Balkan capitals have never echoed to the tread of a conquering Turkish host.

Two broad, parallel streets, connected by irregularly laid out cross streets, comprise the town, which lies hemmed in on every side by the stern hills. The green fields, the elms, the buttercups by the roadside, and the steep gables of the houses, which often lie banked to their eaves with winter's snows, reminded me always of my own White Mountain villages—an impression which was indelibly fixed in my mind on the first morning that I ever saw Cetinje.

I had reached the capital late on a Saturday evening. The next day was set for the inauguration of the new National Theater, and the people were out in force to cheer their ruler as he went from the palace. The hotel at Cetinje stands at the head of the main street, which was filled with Montenegrins in national garb, and as I stepped upon the balcony after my coffee and looked down upon the throng of red-jacketed mountaineers, I thought for all the world that I was in some New England hill town on the day of a firemen's muster.

European dress has made slight inroads in this part of the world. The army now, thanks to Russian generosity, wears khaki; but the guard of honor which accompanied me to the palace when I presented my letters of credence were in Montenegrin garb, and the palace attendants still wear it. It is the habitual dress of both King and Queen, the latter having pointedly refused the suggestion of her daughters-in-law that, together with the royal title, she should take on modern gowns.

COSTLY HIS HABIT AS HIS PURSE CAN BUY

A Montenegrin's habit is as costly as his purse can buy, and there the apparel proclaims the man. The baggy blue trousers are the same for the King or the peasant, as is the gaily colored sash which holds the invariable revolver. But from the red jacket, whether it be embroidered with black or with gold, and from the redingote, whether it be of dark green or a delicate blue, one connotes whether the wearer be a man of substance and consequence or not.

Among the women there are slighter distinctions. All wear a simple dark skirt, a more or less elaborate blouse, and a redingote of blue, though for the peasants the outer garment is likely to be of a coarse woolen stuff of home manufacture.

Men and women alike wear the black-banded red cap, the crown embroidered for the women with some fanciful de-

Photo from Katrice Nicolson

AS EARLY AS SIX IN THE MORNING THE STREETS OF CETINJE WERE FILLED WITH GAYLY DRESSED PEOPLE vice in gold, while the men proclaim their fealty to Nicholas I by ornamenting their caps with his cipher in Cyrillic characters surrounded by five semicircular rows of gold braid to typify the five centuries of Montenegrin independence. I can foresee, in 1984, unless the fashions in the Black Mountain have meantime changed, that a hatter's monopoly in Montenegro will be well worth having.

Montenegrins are nearly all giants and they stride as though each wore seven-league boots. Indeed, when a Montenegrin wants to go anywhere in a hurry he walks, not using the splendid roads with which his mountains are threaded, but taking the old short cuts among the hills.

A HUMAN TELEGRAM

Last spring, when Danilo the Crown Prince was hurriedly despatched to Paris to seek the aid of his brother-in-law, the Grand Duke Nicholas, for the conflict which has since ensued, an important document was found to have been left behind, and no automobile was at hand to send with it to Cattaro.

It was suggested to the King that one Michel, a runner of repute, was about the palace, and that perhaps he could overtake the Prince before his steamer had sailed. So the paper was given to Michel, and the King, who was giving a state luncheon that day, went to the dining-room. Passing through the corridor to his study after the meal, the King saw Michel sitting there and upbraided him for not having gone to Cattaro. "I have just come back, Gospodar," answered Michel. "Ah, then!" exclaimed the King, "you are Michel the Telegram." And Michel the Telegram he now is in Montenegrin speech.

These Montenegrins are a race of warriors, and for years they have sat about in the coffee-houses bemoaning their lot. "What a life for a man!" they have said. "Thirty years without a war; nothing for a man to do."

But there seems to be always plenty for the women to do, and the women of Montenegro, so alert and graceful in their youth, soon lose their good looks and become bent and bowed and ugly; for—but I will give it in the language of General Martinovitch, president of the council of ministers, minister for foreign affairs, and minister of war, and commander of the southern column of the Montenegrin army which has been operating against Scutari. Martinovitch was not always the Poo Bah that he now is, but at the time of which I speak he was minister of war and had arranged a review of troops in honor of the King of Italy, who was visiting his father-in-law.

WOMEN THE PRODUCERS

I dined at the palace that night and took occasion to compliment the minister on the appearance of the soldiers. I asked how many were his effective strength and he said that he could put 50,000 men in the field. I expressed incredulity and said that that number would be one-fifth of all the people in the kingdom—more, I added, than could be spared from the productive pursuits. "Productive pursuits, indeed!" cried Martinovitch. "Don't you know that the women do all the work up here anyway?"

And yet the Montenegrin is a man of capacity and when taken from his bellicose environment of his mountain home becomes one of the best of workers.

In our own Northwest there have been many of them in the mines where they toil industriously as against that day when, with the 10,000 crowns which will make them rich, they may return to their beloved Black Mountain.

His 500 years of freedom have given the Montenegrin a fine sense of order, and it is a current saying along the Dalmatian coast that when a Montenegrin applying for a job is asked what he can do he invariably answers, "Superintend."

The externals of Montenegrin life are simple. In Cetinje there are but two buildings of three stories, and neither of them is the palace; they are the legations of Austria and Russia, whose rivalry in the Near East extends, it would seem, even to the housing of their representatives.

The palace is an unpretentious structure, built some 60 years ago, and, though the famous plane tree before its door beneath which King Nicholas for so many

Photo from Katrice Nicolson

A GROUP OF MONTENEGRIN BOYS

Note the military salute, a sign of the early appearance of the warlike spirit in these unconquered mountaineers

years dispensed a quick and shrewd justice to his people has disappeared, the master of the house remains the same father to his people that he always has been.

THE DEMOCRATIC KING

Access to him, now that he has become a King, is slightly more difficult than in the olden days; but every afternoon he may be seen driving about the streets of Cetinje in a low phaeton, the Queen or one of the princesses with him, and frequently he stops to exchange greetings with one of his intimates or to give to one of his people that highest of all Montenegrin privileges—that of kissing the sovereign's hand.

Wherever he goes he finds the evidences of his rule. As I have said, all Montenegrins bear his cipher on their caps. The same initials, formed of captured Turkish cannon, stare out from the gable of the huge barracks of Cetinje; within sight of his study windows rears the bulk of the new government house which he has built; across the street are the guest house and the home of his second son; from his own garden he can stroll to that of the Crown Prince and thence to the public park which he has created.

Close to one of his gates stands the old *Billiardo*, whose name is shrouded in mystery; for none can declare with certainty whether it is because the building once had at its corners little towers which looked like the pockets of a billiard table, or because in one of its rooms was installed the first billiard table in the kingdom. In this little building Nicholas was voted his royal title, and there the Council of State has its apartments.

On another corner of the little Place du Palais is the long, low dormitory of the old monastery. In its upper rooms Danilo II taught his chiefs to read and write, while further on, at the base of a high hill, stands the monastery itself, the most interesting building in Montenegro, for here were made the desperate defenses against the Turks which have

Photo from Katrice Nicolson

SOME FELLOW-TRAVELERS IN MONTENEGRO

With their pistols in their belts, they were rather fierce looking, but they proved to have the kindest hearts possible

enriched the Montenegrin legend with so many tales of bravery.

A NATIONAL SHRINE

This venerated stronghold and sanctuary of faith and freedom in the Black Mountain stands on the spot where, in 1484, Ivan the Black established himself upon moving his seat of government from the shores of the Lake of Scutari to Cetinje, and where he established the first Slavonic printing press, whose four hundreth anniversary was celebrated with much rejoicing a few years ago. A century and a half later it succumbed to the Turks, but was soon retaken by the Montenegrins, who descended in force from the Lovcen, whither the invaders had been unable to follow them. Two centuries and a quarter ago it was blown up by the monks themselves, who perished with their precious books and documents rather than see their sacred walls again degraded by the Moslem foe.

But again and again the structure has raised its benignantly defiant front. In

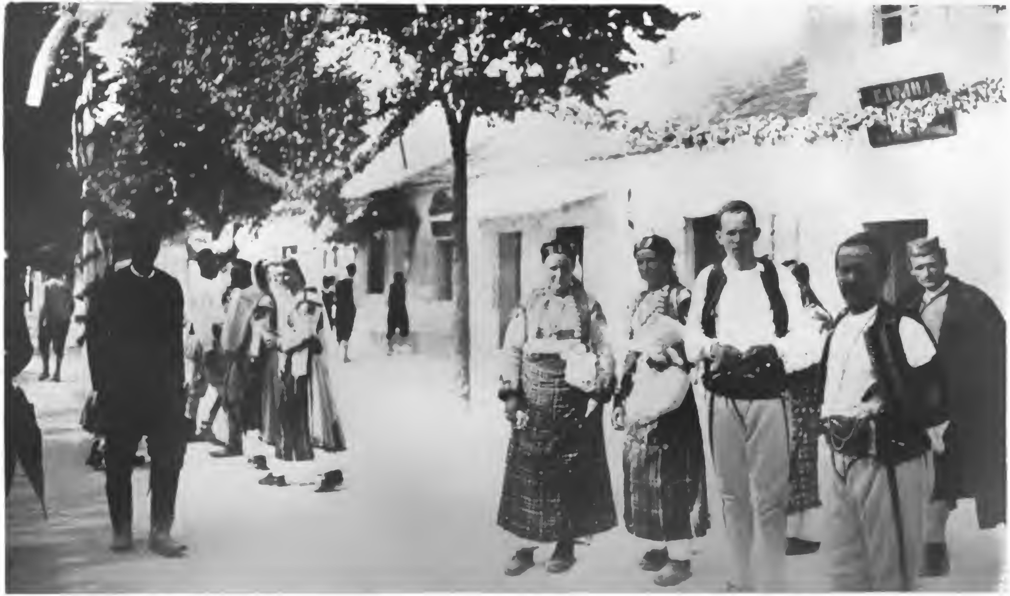


Photo from Katrice Nicolson

PEASANTS IN CETINJE FOR A FETE DAY

Photo from Katrice Nicolson

WHEN PRINCE NICHOLAS BECAME KING NICHOLAS I THERE WAS GREAT REJOICING AMONG THE PEOPLE

its present appearance it dates only from the 18th century; but its quaint clock tower and shaded cloisters give it an impression of a much greater age.

Here rest many of the Vladikas; here are to be found the cannon captured from the foe on many an historic field; here is preserved a page from the first gospel issued from the famous press (whose type were afterward melted down to make bullets), and it is little wonder that the Montenegrin peasant making his way to market at Cetinje pauses as he glimpses the shrine from afar and crosses himself devoutly as he whispers a prayer for the Black Mountain and its Gospodar.

GRIM RELICS OF THE PAST

Above rises the Tower of the Skulls, the old-time citadel of the monkish defenders, which takes its name from the fact that up to within a short time it bore grisly fringes of Turkish heads impaled upon its ramparts. These grim reminders of a gory past were dear to Montenegrin veterans, and many were the murmurs of disapproval when the Gospodar concluded to remove them.

Life in Montenegro centers in the King, who is greater than the ministry, the chamber, or the constitution, who all owe their creation and preservation to his grace. More than any other sovereign of whom I know he fits his legend. Nicholas I, "King and Gospodar of free Cernagora and the Berda," is the most picturesque and remarkable figure in the southern Slavonic world, to say the least. Descended from a long line of heroes—the heir of the Vladikas—he has, like them, distinguished himself in many a hard-fought conflict.

As a lad he was with his father, Mirko, the "Sword of Montenegro," at fateful Grahovo, and like Mirko, too, he has written lyric odes and ballads. Like his ancestor, Peter II, he has composed historical dramas and given laws, and, like all his line, he has at all times displayed a courage and a capacity fitting every occasion.

THE NATION'S TYPE AND HERO

The inheritor of a splendid tradition, a warrior and a bard, gifted by nature with a fine physique and a commanding presence, he personifies and embodies all that appeals to the imagination of a romantic and impressionable people, to its martial instinct, its poetic temperament, and its yearning for long-vanished glories.

He is a statesman at once bold and cautious, a diplomatist of many talents,

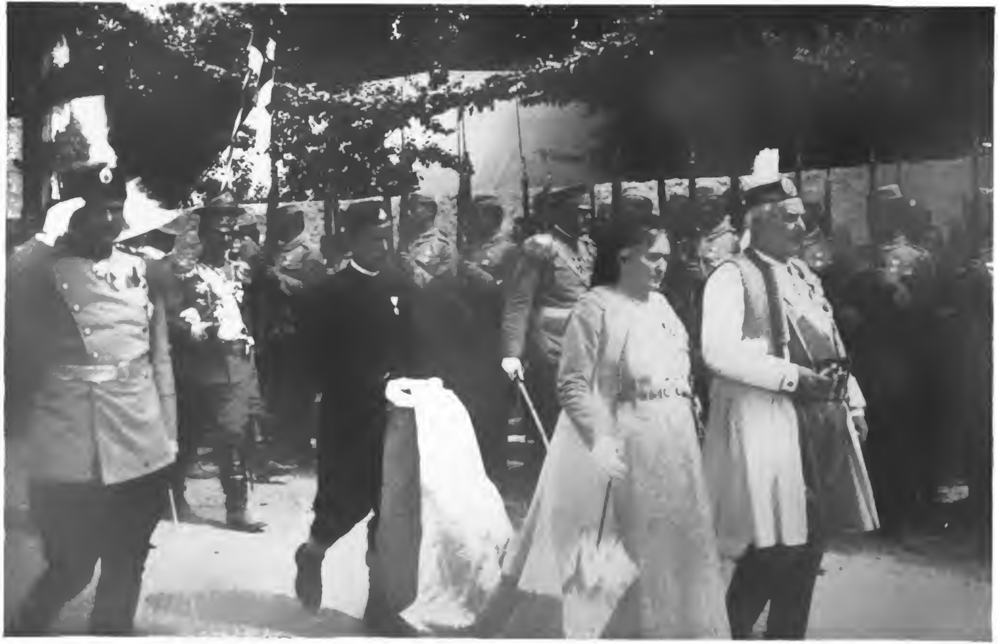


Photo from Katrice Nicolson

PRINCE NICHOLAS AND PRINCESS MILENA GOING TO THE PALAIS DU GOUVERNEMENT TO BE PROCLAIMED KING AND QUEEN ON THE 50TH ANNIVERSARY OF HIS ACCESSION TO THE THRONE AND ON THE OCCASION OF HIS GOLDEN WEDDING a capable administrator, and a thoughtful reformer. Again and again he has repressed the war-like ardor of his mountaineers, and has led them to battle only when no other course was possible.

But whether he has fought or remained tranquil he has always profited. Like his royal cousin at Sofia, Nicholas of Montenegro is a skillful international trader; and as I have seen him in stormy times negotiating now with the revolutionary Albanians and now with the Turks, I have often wondered if his intellectual inheritance was not as much of the White as of the Black Mountain.

He was but yet a boy when the assassin's bullet brought him to his uncle's place, to the place of that uncle who had launched the ***nolo episcopari*** at the heads of his astonished people, but whose marriage remaining childless has seen the crown pass in its usual succession from uncle to nephew, so that if Nicholas shall give place to Danilo it will be the first time in Montenegrin history that a son has followed a father upon the throne.

WHAT NICHOLAS HAS DONE FOR HIS LAND

Nicholas was then a little lacking of 19 years, but his education in Paris and his experiences at home had given him wisdom beyond his years, and his tiny land has profited by it mightily.

He has already doubled his territory, and now expects to gain much more. He has added two Adriatic ports to his possessions. He has organized ministries, the courts, finance, and all the departments of government. Where, when he came to the throne, only a few difficult trails threaded the hills, today a splendid network of roads connects all the principal points of the kingdom, and it may be said of Montenegro alone among nations, I hazard, that wherever one may go at all in a wheeled conveyance one may go in an automobile.

He has established posts and telegraphs, so that whereas once a Montenegrin mobilization was effected by stentorian hallooing from peak to peak, Cetinje is now constantly in touch with all parts of the country and with the outside world.

He has codified the laws, a task already begun by his predecessor; and while he has modernized procedure in a degree, there yet remain many quaint survivals of the days when the Vladikas made law by whim or wrote into the statutes the superstitions of the people. For example, by law in Montenegro the eating of a hedgehog is regarded as an offense against nature, and not long since a peasant was imprisoned for it.

Respect for age is enjoined by law, and in the articles regulating public conveyances it is provided that the traveler may have the seat indicated by his ticket, but it is added, "The deference due by youth to age requires that the former yield the better place to their seniors." Another article declares the equality of all before the law, and lays down the democratic principle of the universal ownership of land and equal right of all to hold office.

Another allows a man who is struck to kill the striker, provided it be done at once. If he delays, it is murder. In short, the Montenegrin code aims to be the embodiment of that "civil and religious liberty" which, it avows, is "the reward of valor."

THE PRINCE BECOMES A KING

Probably Nicholas himself would count the chief among his achievements the assumption of a kingly title upon the completion of 50 years of rule. The jubilee, the royal honor, and the king's golden wedding were coincidently and joyfully celebrated at Cetinje.

Those were splendid days for the Petrovitches, who gathered in force. Preeminent among them, of course, was the beautiful queen of Italy. With her were the two stately grand duchesses of Russia and the Princess of Battenberg, whose marriage had led the King to retort to one who had taunted him that Montenegro had no exports, "Sir, you forget my daughters." There, too, was the son of the King's dead daughter, the Crown Prince of Servia, and the three princes and two charming princesses who make up the royal group at home.

Thither came the Tsar of the Bulgars and the Crown Prince of Greece. The Sultan sent a special embassy, but other

Photo from Katrice Nicolson

SHALLOW WATERS OF SCUTARI LAKE

nations contented themselves with sending letters of felicitation by the hands of their ministers in residence, and among them the American alone was able to hail Nicholas as King, for Mr. Taft had taken care to address his great and good friend as His Majesty, and Nicholas has never forgotten that the American President was the first chief of state who addressed him as King.

There, too, were the deputations from all the clans of the Black Mountain, and as they passed before the palace and made their obeisance to the Gospodar one was struck with the instinctive and natural grace of these Highlanders, whose courtesy is the fruit of their centuries of freedom.

MOTOR CARS ARE SCARCE

Nicholas alone of Balkan monarchs lives among his people—an undertaking which is rendered easier by the limits of his kingdom. At every considerable town there is a royal villa, and among the delights of life at Cetinje is the privilege of automobiling with the King to spend the week end at Rieka, Krusovac, Niksic, or Antivari.

Practically the only motor cars in Montenegro are those in use by royalty, and as the machines purr along the splendid roads all the peasants working in the fields, even the most distant, straighten themselves and make a deep obeisance as the car passes, and at every halting place the people swarm up to see if they may have the privilege of kissing the royal hand.

It has been my good fortune to make frequent excursions of this kind, and once, as we went to Niksic, we were less than two hours from Cetinje when we entered upon the territory which Nicholas himself had taken from the Turks during the Russian war. Passing north from Podgoritza, we soon passed the old Turkish stronghold of Spuzh. Spuzh is a perfectly conical hill set in the middle of the meadows of the Moraca River. It had been a fortress in Venetian times, and their old battlements, as strengthened by the Turks, still crown its heights.

As we bowled along the King described the campaign which resulted in the capture of the fortress. On every hand were the reminiscent landmarks.

Photo from Katrice Nicolson

PASSENGERS ON SCUTARI LAKE

Over this hill he had dragged his cannon with men and ropes. Upon that height was Suleiman Pasha with 30,000 troops. At this spot was a Montenegrin brigade. From this the assault was ordered. "And what is there now, sir?" I asked. The King drew himself up and answered solemnly, "Seven million Montenegrin cartridges!" And it is worth noting that the only manufacturing establishment of consequence is the cartridge factory.

"AN ATTILA WITH MACHINE GUNS"

South of Spuzh lies Podgoritza, once Turkish, and still retaining the minarets and the unkempt Moslem cemetery to point to the order that has passed. It is the most considerable town of the kingdom, yet it has no more than 6,000 inhabitants.

The Albanian frontier lies but a short distance to the east, and during the Albanian revolution of 1911, as we sat in the square before the dismal hotel sipping our evening coffee beneath the mulberry trees, we could watch the twinkling campfires of Torgut's column moving upon the rebellious Malissori—"like an Attila with machine guns," as Miss Durham used to say.

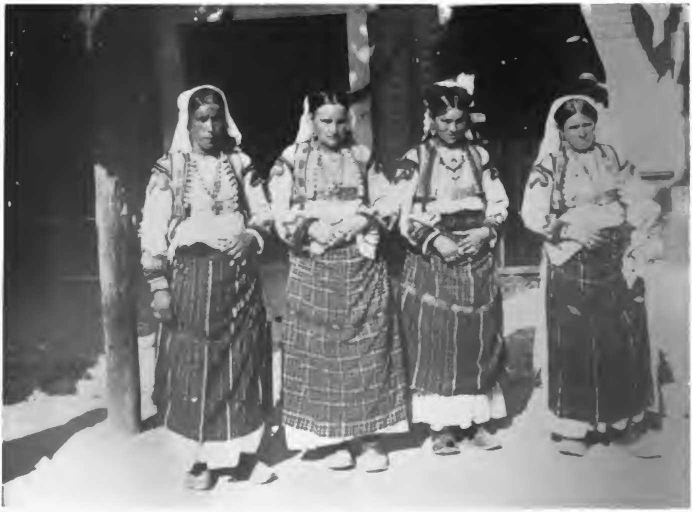


Photo from Katrice Nicolson

SOME MOUNTAIN WOMEN IN MONTENEGRO

From Podgoritza north one passes Danilograd, where the King has established a flourishing agricultural experiment station which will probably be found of use to his people, now that their thirst for blood has been slaked, and an asylum for the insane, which is almost tenantless.

Next comes Niksic, another of the spoils of the last war, where the King has built a villa directly facing the old Turkish fortress which he had captured and from whose ramparts he proudly flies the royal standard when he is in residence. Next to the villa stands the church, a fine structure, designed by Nicholas and erected to the memory of the heroes of the war of '77. Here, too, is the principal prison of the realm, whose inmates are allowed great freedom, and the one symbol of progress of all the world—a brewery.

Between Danilograd and Niksic lies Ostrog, the famous mountain monastery and stronghold, whither withdrew, two centuries ago, St. Vasili, Metropolitan of the Herzegovina, and founded the shrine so often besieged and so valiantly defended—once by only 28 men, under Mirko, King Nicholas' father, who held at bay 10,000 Turks for eight days and then succeeded in making his escape at night.

THE PORT OF MONTENEGRO

Antivari, the chief seaport, is a thriving place. Taken by Nicholas himself during the Russo-Turkish war, he has built a new town directly on the shore, two miles or more from the old Turkish city, up among the Albanian foothills. Here is one of the numerous royal villas, and here the Italian concessionaires have poured out their lire in making a port and building a railroad which zigzags up the hills and darts through a tunnel near the summit before beginning its tortuous descent to the Lake of Scutari beyond.

There is little commerce and almost no manufactures in the Black Mountain.

Photo by Emma G. Cummings

GREEK PEASANT STANDING BEFORE HIS HOUSE, BETWEEN BRALO AND DELPHI

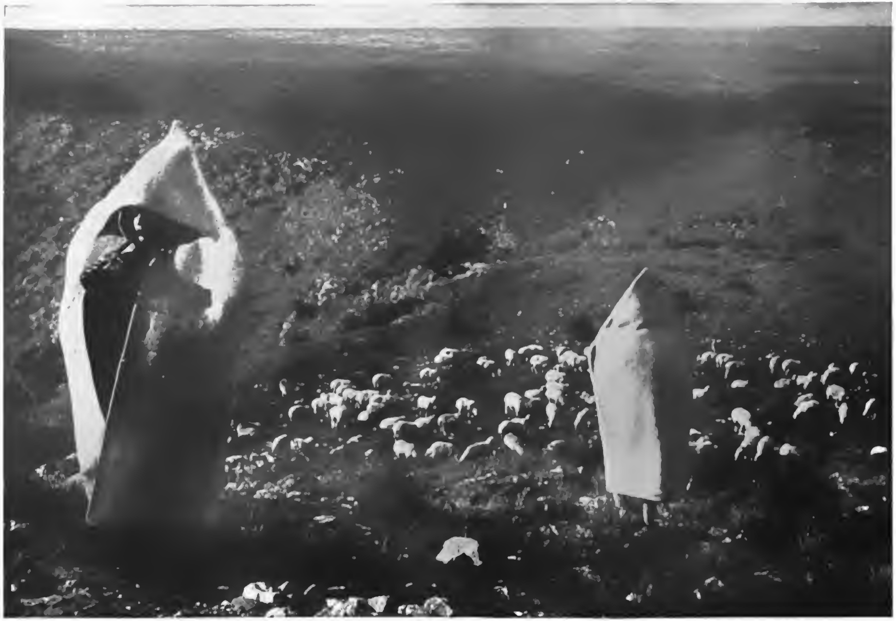
The tobacco is excellent, and an Italian company has its monopoly. A few coarse stuffs are woven at Podgoritza, but practically everything is imported. Duties are high and prices are extortionate.

Happily the people's wants are simple; but to bring even a scanty living from the reluctant soil requires unremitting industry. Everywhere, in sheltered nooks and upon the gentler slopes, the earth has been painstakingly gathered up behind retaining walls, and the gray hillsides are dotted with these little patches of green, most of them no larger than a tablecloth.

Near the Lake of Scutari the vine grows luxuriantly, and it is one of the King's hopes that some day, when permanent peace shall have fallen upon the Black Mountain, the fertile meadows may be drained and cultivated and that Montenegro may become the granary of that portion of the world.

RELIGION AND EDUCATION

The established religion of the land is, of course, Orthodox Greek. The clergy, headed by the Metropolitan of Cetinje, are a splendid lot of men in physique and character. The Catholics, numbering some 13,000, have their own archbishop



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LOOKING WEST FROM THE ACROPOLIS OF TROY, TOWARD BURNABASHI

The mountain on the sky-line marks the Island of Tenedas, which is just opposite the harbor of Troas. Where once the ancient City of Troy reared its majestic walls, sheep now find pasture, while the shepherds in their peculiar dress while away the dreary hours by playing on their flute of reeds.

at Antivari, and the few Mohammedans possess a Grand Mufti.

Perhaps the most striking testimony to Nicholas' tact as a ruler is to be found in these three religious groups dwelling amicably together and all possessing and professing a like affection and honor for their Sovereign.

Education is not advanced. The schools are few in number and most elementary in character. At Cetinje there is the Institute for Girls, founded by the Empress Marie Feodorovna of Russia and maintained by Russian bounty. Here several score of girls are trained in domestic arts, music, and the studies which with us are preparatory to high-school work. This school has had a large influence upon Montenegrin life, and, thanks to it, the position of woman is becoming each year more tolerable.

Another Russian establishment is that for the training of cadets, and indeed it would be difficult to find any Montenegrin activity where Russian influence is not exerted. A Russian subsidy maintains the army, and two years ago from Russia came arms, uniforms, tents, cannons, saddlery, and the complete equipment for 50,000 men. A Russian military commission has been busy at Cetinje for years, and the Russian military regent has long been a most conspicuous figure in Montenegrin life.

WHERE RUSSIAN INFLUENCE FAILED

Yet Russian influence was unable to restrain the Montenegrin initiative in the present war, and King Nicholas never showed to better advantage than when he informed the spokesmen of the Great Powers that they had come too late. Within an hour from that declaration he had sent the Turkish Minister his passports, and the next morning we heard the first gun in the war whose results have so astounded the world.

If I have seemed to give too large a share of my allotted theme to the consideration of Nicholas and his Black Mountaineers, my excuse is that the other portion of it is measurably familiar.

To separate the life of modern Greece from the splendors of its classic or Byzantine days is not easy, and the Greeks themselves would be the first to resent it. They, of a truth, deem themselves the direct descendants of the worthies of classic days, and certain it is that their life has shown a persistent continuity which warrants the claim.

Whether their land has been ruled by a Roman emperor, a Frankish duke, a Venetian baillie, or a Turkish pasha, the thread of Hellenic existence has remained unbroken. In the monasteries have been preserved their religion, their tongue, their traditions; mothers have taught their children the glories of the Greek heritage, and today the Greek people stand forth in character, at least, exactly as they did in days of yore, as Aristophanes pictured them, as St. Paul described them, and as every classical scholar has learned to regard them.

THE PARIS OF THE LEVANT

In many ways Greek life remains unchanged from its classic aspects. Modern Athens, to be sure, is a brilliant capital well worth its title, "The Paris of the Levant." Less than a century ago it passed finally from Turkish possession, and it was then a small collection of mere hovels huddled beneath the Acropolis.

Today it is a city of wide and gay streets, dotted with small parks and adorned with many handsome public buildings, most of them the gifts of rich Greeks who have delighted to spend in the mother country the fortunes which they have earned abroad.

To such generosity Athens owes the noble group of buildings which comprise the university, the National Library, and the fine classic reproduction which houses the Academy of Science, and above all and to my mind the most interesting, the noble stadium, built upon the old foundations and along the old lines and ingeniously carrying in its fabric every fragment of the old structure which could be found.

In the midst of all this modernity stand the remnants of the golden days of Athens sedulously preserved, and open to inspection and study with a freedom nowhere equalled. The focus, of course, is

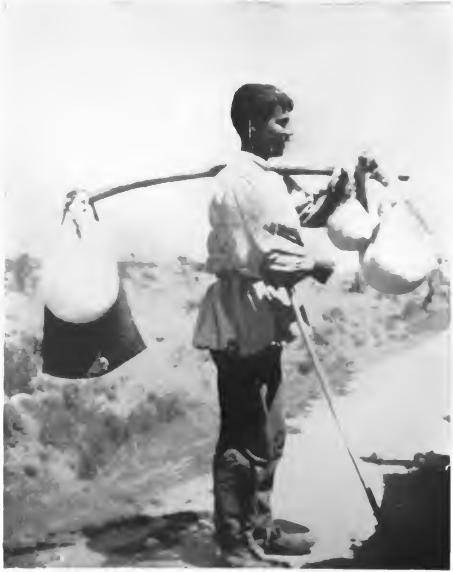


Photo by Emma G. Cummings

GREEK PEASANT CARRYING MILK

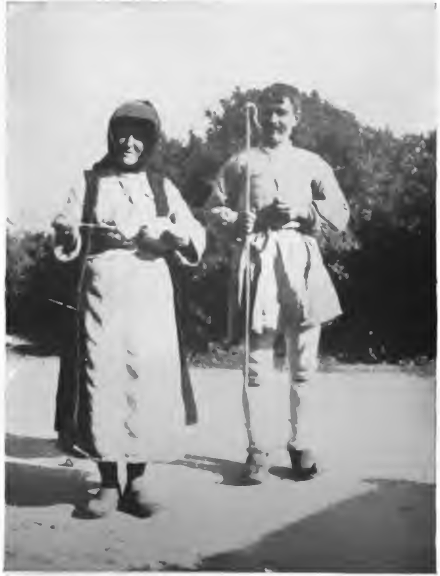


Photo by Emma G. Cummings

GREEK SHEPHERD AND SHEPHERDESS IN THE PELOPONNESUS

Photo by Emma G. Cummings

PEASANTS AND FLOCK, NEAR EPIDAURAS, GREECE

the Acropolis—incomparable even in its ruins—its cliffs and grottoes still the home of legend and of fable.

All the cycles of Athenian life are represented. The classic temple of Theseus, best preserved of all the ancient monuments, recalls the days of Pericles. The Stoa of Hadrian speaks of that distant day when a Roman conqueror ruled the violet crowned city.

While the early Christian era finds its survival in the beautiful Byzantine churches, the most striking of which is that of St. Theodore set down in the midst of one of the great business streets of the city and scrupulously guarded from encroachment. Of Turkish days there remain few traces, though the bazars, as typified by the Lane of the Little Red Shoes or Hephaestos street, the home of the coppersmiths, are more oriental than Hellenic or European.

In this land of changing allegiance the marks of Venetian rule were set deep and strong. Corfu today, in its externals at least, is more Italian than Greek, while Nauplia, Patras, and many of the island seaports still find useful the battlemented fortresses erected by the Latin rulers.

"A GRAVE NATIONAL HEMORRHAGE"

As of old, the Greeks swarm the seas. The Piræus is one of the busiest of Mediterranean ports—indeed, it is the center of transhipment for all the East—while the Corinthian Canal, after many financial vicissitudes, now seems to be in the way of becoming each year a more and more useful route between the Ionian and the Ægean Seas.

The Greeks are a town people. One-tenth of the population is to be found in Athens and the Piræus. The drain of emigration from the rural districts is enormous. In the words of a Cabinet Minister, it constitutes "a grave national

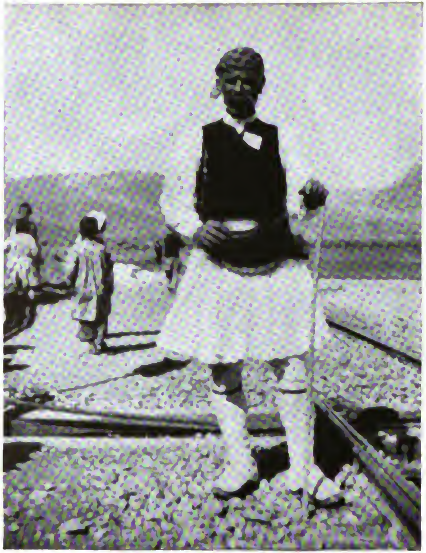
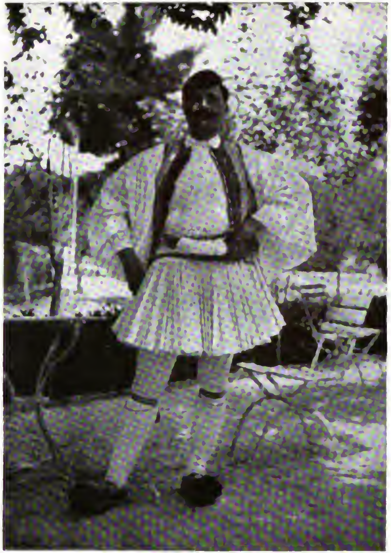


Photo by Emma G. Cummings

GREEK PEASANT AT MYCENÆ

"At Megara the native costume appears at its best. It is rarely seen anywhere nowadays, and has almost wholly disappeared from the cities. But for the Evzones, or household troops, the fustanella would be as rare a sight in Athens as the classic garb, which is worn only by Americans" (see text, page 303).



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GREEK IN SUNDAY COSTUME

Showing the fustanella, the kilt of white cotton or linen, which is worn very full and starched. It is worn by the Greek peasants on holidays and by the royal bodyguard of the King of Greece. It is, however, of Albanian rather than of Greek origin, and is found in the Albanian colonies in southern Italy.

hemorrhage." Indeed, in some villages in the Peloponnesus there remain scarcely enough men to fill the offices.

In one sense, however, the emigration has been of benefit to the country, for large sums of money are sent back each year, especially from America, to the families who remain behind, and to this may be traced the gradual appreciation in the Greek paper currency, which, as against a depreciation of some 40 per cent, is now, and has been for several years, at par or better.

I remember that my bankers, in 1911, were able to buy Napoleons at 99 and a fraction in Greek money, and it was at this time that the wife of one of my colleagues complained that, owing to the high price of the drachma, she felt unable to keep an automobile.

Country life in Greece remains in many of its aspects as it has been for ages. Within two hours' drive of Athens I have seen peasants plowing with a crooked stick exactly as they did, I imagine, in the days of Homer. The shepherd boys of today manage their flocks with a crook that bears the lines of that carried by Corydon. And in Thessaly one sees the solid-wheeled cart which has come down without substantial change from the days of Jason. The distaff remains as the chief instrument in preparing the wool for the hand-looms, and is rarely absent from the busy fingers of the older dames; and the women gather at the fountains for their washing as did Nausicaa and her maids did on that day when Odysseus came to port.

THE GREEK LIVES IN THE OPEN

In a land of much sunshine, as Greece is, life is followed much in the open. The oven is almost invariably to be found in the courtyard, and it is heated with dried twigs, almost the only fuel of the country, which are brought in huge piles upon the backs of the patient little donkeys, who vie with the goats in being the most useful members of the household.

Market day, of course, brings all the community together, and is generally an occasion of much gaiety, while the feast-days, which are numerous, are literally observed. On these occasions there is always dancing, the most famous to be seen at Megara during the feast of Easter week. Megara prides itself upon being a pure Hellenic community in the midst of the Albanian strain, which predominates in Attica, and its Easter dancing was once a famous marriage mart. It no longer serves this purpose, because, as the maidens sigh, so many men have gone off to America.

At Megara the native costume appears at its best. It is rarely seen anywhere nowadays, and has almost wholly disappeared from the cities. But for the Evzones, or household troops, the fustanella would be as rare a sight in Athens as the classic garb, which is worn only by Americans.

The church plays a large part in Greek affairs, and rightly; for it was the church which kept the national spirit alive during the long night of Turkish rule. It was from the famous monastery at Kalavrita, that the Archbishop Germanus unfurled the flag of rebellion in the war for independence, and this famous shrine has been more lightly dealt with than the most of the monastic establishments, which have now come under strict governmental supervision. Another favored monastic group is that at Meteora, in Thessaly, where the quaint buildings, perched upon their needles of rock, afford a fascinating risk to the venturesome visitor.

THE ORACLE AT DELPHI SPEAKS AGAIN

It is not yet easy to go about in Greece. The railroad lines are meager, the roads are not good, and the hotels leave much to be desired. The most accessible of all the great centers of classic life is Delphi, a fitting shrine for an oracle, with its massive cliffs and majestic hills. Here the French have brought to light the ancient city with its treasures, its wonderful Castalian spring, its theater, and its sacred way.

That it still retains its oracular powers I can testify; for when I was last there, about a year ago, my Dutch colleague stood upon the spot where Baedeker told us the tripod and the priestess had sat. "Who will be the next President of the United States"? I asked, and the oracle said solemnly: "The best man will win."

Photo by Emma G. Cummings

PEASANT WITH DISTAFF, SPINNING AS SHE WALKS

The Greek royal family are claimed as the best looking, the most charming-mannered, and the best behaved royalties in Europe. I believe it to be true. Court life is democratic and simple, the late King much preferred his life as a farmer at the Château of Tatoi to that of the palace at Athens. Queen Olga and the princesses devote themselves to good works, and the princes have so recently given such good account of themselves on the field of battle that words of mine are needless.

My chief criticism of modern Greek life would be that the young men of good family and of fortune have not turned themselves to the economic development of their country. Manufacturing and agriculture have been almost wholly neglected, and all that one wears and much of what one eats is brought from abroad. The owners of estates have considered them chiefly useful as a foothold for a seat in Parliament—that one-chambered and often turbulent body where have centered the chief defects in Greek development.

POLITICS THE CURSE OF THE GREEKS

To speak the truth, the curse of politics has overlain all Greek activities since the establishment of the kingdom. And politics in Greece has meant a sordid thing. There are no questions of principle which divide parties there. Economic conditions demand high tariffs; on foreign questions there is no division; sociological problems have not developed along party lines—and so it has happened that parties have now grown up with well-defined lines of cleavage in policy, but have arisen from time to time in accordance with the ambitions or political necessities of individual leaders—and the struggle has been wholly between the ins and the outs.

Thus it has happened that maladministration has been the rule. I have never inclined to the belief that Greek administration has been dishonest. In fact, the modest budget forbids graft on any scale to be really dangerous, but wastefulness and poor service have been common to all ministries.

I speak of this in the past tense, be-

Photo by Emma G. Cummings

SITE OF THE ROYAL TOMBS, DISCOVERED BY SCHLIEMANN IN 1876, WHICH CONTAINED AN EXTRAORDINARY QUANTITY OF GOLD AND OTHER ORNAMENTS

The circular space in which these were found was inclosed by a double circle of upright stone slabs, covered with horizontal slabs

cause I believe that a new day has dawned for Greek public life. The bloodless revolution of 1909, which had its origin in the determination of a group of officers to purge the army and the navy of their political ills, has gone much farther than its authors had foreseen, and as a result Greek hopes now center in one man, who, brought to Athens from turbulent Crete to rescue the Military League from the depths of the parliamentary muddle into which they had fallen, became in 10 months the prime minister of Greece, and in three weeks thereafter had demonstrated himself the master of a situation which had baffled all of his predecessors.

A GREEK BISMARCK

This man, Eleutherios Venizelos, is a Greek of the Greeks, with a long line of distinguished Hellenic ancestry. Educated at the University of Athens and in Switzerland, he was established himself as an attorney in Crete, and was active in the revolution movements which brought on the Greco-Turkish war of 1897.

Upon the establishment of the High Commissioner's regime in Crete, Venizelos and Prince George were not in accord, and the prince's withdrawal from the island followed—an incident which led the court party in Athens to regard Venizelos as an arch-revolutionary and to render his task the more difficult.

The Greek people, however, have never wavered in their support of him. He is their idol—and he justifies their idolatry. Summoned to the prime ministry much earlier than he had believed himself ready for such power, and knowing full well that he owed his preferment in a large measure to the wishes

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SHIP CANAL, LOOKING EAST: ISTHMUS OF CORINTH, GREECE

The idea of a canal through the Isthmus of Corinth dates from Roman times, when the Emperor Nero started excavations in the year A. D. 67, but the project was soon abandoned, and not until 1893 was the canal actually opened. It is nearly 4 miles long, some 70 feet broad, and 26 feet deep, but the strength of the current running through it, together with its narrowness, impedes its full usefulness.

of the old political leaders, who had conceived the notion of choking him to death with power, he has confounded his enemies, amazed his friends, and justified all the fond hopes of the people, who regard him as the embodiment of their future and who have never ceased to hail him as the savior of Hellenism.

Twice his ministry has been forced to appeal to the electorate—once by his own wish to test Greek public opinion and once because the constitutional limit had run against his government. In each case he has been swept back into office with a majority of cumbersome proportions—and he has rightly counted himself as a man with a mandate to reorganize Greece.

Photo and copyright by H. C. White Co.

MEDIEVAL FORTIFICATIONS OF THE ACRO-CORINTH: CORINTH, GREECE

Under his guidance the constitution has been revised, the chamber has been liberated and set in the way of constructive legislation, while the electorate has been given a wider privilege of choice of their representatives. The courts have been given tenure and removed from political control.

The ministries have been reorganized and purged and the civil service has been set upon a merit basis. Agriculture and commerce have been taken under the charge of a new ministry. Municipalities have been granted new rights and charged with new duties; and a general quickening and efficiency have been infused into all branches of the administration.

THE ORIGIN OF THE BALKAN LEAGUE

Emphasis, however, has been laid upon the work of reorganizing the army and the navy, and French and English commissions have respectively undertaken that task. How well they have succeeded was foreshadowed at the joint maneuvers of last spring and demonstrated beyond question in the engagements of the war which is now drawing to its close.

To Venizelos, more than to any other,

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MONASTERY OF HAGIA TRIAS (HOLY TRINITY), ON THE MARVELOUS METEORA ROCKS, NORTHERN GREECE

is due the Balkan Federation. His was the initiative that opened the negotiations, and it was his controlling political genius that shaped the *entente* in most of its details. The powers of Europe and its diplomats were staggered by the news of his success. Though well warned by frequent rumor during the year and a half that the negotiations were in progress, they refused to think it possible that two races who had dealt with each other as ferociously as the Greeks and the Bulgars in Macedonia could be brought into accord, no matter how great the stake.

Yet nothing was more obvious than this, and from the moment that Venizelos came to power in Greece and called to his side that talented statesman, so well known, from his service in the United States as Minister of Greece, it was evident that the long-cherished ideal of Balkan statesmen for an effective agreement toward an amelioration of the lot of the subject Christian peoples in European Turkey was in the way of realization.

A Balkan federation has long been dreamed of, and the first steps toward its attainment were taken some 30 years ago by the then Prime Minister of Greece, Charilao Tricoupis, of whom it is said by the ardent Venizelists that he was an earlier Venizelos, while the Tricoupists refer to Venizelos as another Tricoupis. That attempt failed, and for nearly a generation the Balkan *entente* was relegated to the realm of academic discussion.

In the meantime the Turkish policy "Divide and rule" had set the Greeks and Bulgarians at each other's throats, and there had ensued an era of blood in Macedonia, wherein the province was ravaged by marauding bands of Greeks, Bulgars, and Serbs, who waged a war of extermination against each other.

This barbarous policy had carried itself nearly to exhaustion when Venizelos came to power at Athens, and to him it was suggested that an attempt at a definite agreement be made among all the nations having racial pretensions in Macedonia and Albania.

A beginning was made at once, the first exchanges being purely unofficial. It was soon found, however, that formal undertaking were possible, but it was nearly a year before any effort was made to reduce to terms the basis of agreement.

THE MONROE DOCTRINE OF THE BALKANS

It was thought best to simplify the first declarations, and the same counsellor who had first engaged Venizelos' attention to the subject advised that the Allied States should unite in a promulgation of a Monroe doctrine for the Balkan States. For this policy the lamented Milovanovitch, then Prime Minister of Servia, became the spokesman, and one of his last—as it was surely the most important—of his public utterances was a speech in the Skuptchina at Belgrade declaring the doctrine of the Balkans for the Balkan peoples.

Nearly coincident with this came the transfer of Mr. Coromilas from the ministry of finance at Athens to that for foreign affairs, and the negotiations took an immediate impetus from his active persistence. The early summer saw their completion, and for the first time the Balkan States were in position to present a united front to their traditional enemy.

The Balkan Federation was not, however, predicated upon immediate war. Greece, at any rate, felt herself unready. The work of national reorganization under Venizelos' lead was far from complete. The finances, to be sure, were in excellent condition. Indeed, Greece alone among the allies had any considerable sum of money on hand when hostilities began. But much remained to be done with the army, and the navy was awaiting the new battleship for which the contract had only just been awarded. And, on the whole, the allies preferred a peaceful solution of the difficulty if it could be had.

Their fundamental desire was to secure tranquillity and good government in Macedonia and Albania, believing that with this the evolution of time would bring to them their natural zones of influence, even as eastern Rumelia had been added to Bulgarian territory. They calculated not a little upon the fetich of the *status quo*, which had always been before the eyes of the Great Powers, and they reckoned that an effective intervention would prevent their coming to grips now.

A NEW ERA FOR THE NEAR EAST

Their plan in brief was to mobilize and to present an identical note to the Porte demanding immediate reforms in Macedonia and Albania, at the same time notifying the powers of their action and of the terms of the note. Their expectation was that the powers, fearful of the long-dreaded explosion in the Balkans, would then step in and enforce the major portion of the demanded reforms.

It must be admitted that the allies had no considerable confidence in the results of these reforms as administered by Turkish authority, and that they felt that conditions would again be beyond endurance after a few years; but by that time they knew that they would be ready for war, and were content.

The general lines of this program were carried out. The powers, as so often before, failed to meet the expectations of the allies and drafted an ultimatum to the Balkan governments, the terms of which were almost immediately made ridiculous by the fortunes of war. The rest is now history; and when the treaty of London is finally cast into enduring terms, it will be found that the Balkan allies have remade the map of Europe as none have done for a century.

Will it prove that they have also put an end to the specter which has so long lurked behind every aspect of the Near Eastern question? That they have found tranquillity for lands long harassed? That they have, to use the words of Lloyd-George, extended the boundaries of liberty and good government? That they have brought deliverance to the oppressed?

That they have, in short, opened a new era in the Near East, in the course of which those long in terror and subjugation may enjoy life, liberty, and the pursuit of happiness, and in which a plenteous prosperity shall reign in a region where desolation and poverty have so long held sway?

They so believe, and I with them.

MEGASPELÆON, THE OLDEST MONASTERY IN GREECE

By Carroll Storrs Alden

With Photographs taken by the Author

I REMEMBER the consternation with which, when a small boy, I heard my uncle observe that Americans were overrunning Europe, and that in a few years there would be not even a village they had not visited and made common. The doom of Europe was thus pronounced. With dismay I realized that when I became a man and traveled like my uncle, Germany, Russia, and all other lands would be completely tamed; I would see them but as Chicago (my home city) repeated again and again.

However, Europe is like one of those old home-spun garments which, though slightly faded, is extremely durable; and, as patching is not an easy process, most of Europe still remains Europe. Americans are far from being everywhere, and on going to Greece in a recent summer I wandered for several weeks through city and village, and outside of Athens met just three of my countrymen—one man and two college women.

Under such conditions the sociable man is likely to feel intensely lonely, and it is curious how he will sometimes encourage himself, as he might a child, by appealing to his pride; thus, if I did not emphatically approve, at least I made no remonstrance as the solitary young Texan I met at Tiryns denounced our countrymen as poor creatures of convention, traveling only where thousands had preceded them, and shrinking timidly when they encountered the least hardship. "They're even afraid of dirt," he contemptuously concluded. It was plain that he was not, and I presume that I also bore the dark badge of courage.

THE MONKS IN THE CAVES

One of the places in Greece fairly easy of access, yet rarely visited by Americans, is the monastery of Megaspelæon. As the name signifies, it is the monastery of the *Great Cave*, and the cave-dwellers, though not belonging to prehistoric times, are like a relic of the middle ages.

It is the oldest of Greek monasteries, tradition affirming that it was founded in the fourth century; probably the real date is about 1,000 years later; it is also the richest, for it has extensive holdings

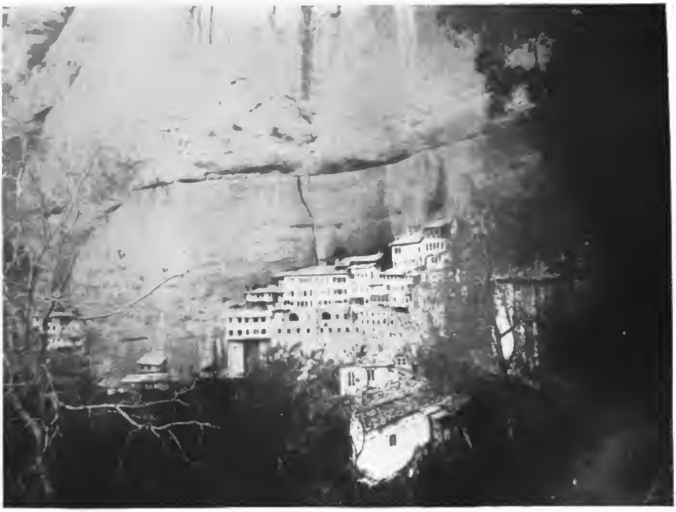

Photo by Emma G. Cummings

ROCK MONASTERY OF MEGASPELÆON, THE MOST IMPORTANT IN GREECE, ON THE SIDE OF A GREAT CLIFF

The buildings date from 1640. The monks derive their income from extensive lands in the neighborhood and also from houses in Smyrna and Constantinople

in Elis and other States, and with the growing prosperity of Greece these lands are rapidly increasing in value, making Megaspelæon one of the richest monasteries in all Europe. About 140 monks at present live here, not including those whose duties, such as collecting the rents, keep them much of the time away. They have a government like that of a republic and they elect their own abbot.

Half way between Corinth and Patras I had left the main railway and took a cog-road that winds its way up a rocky gorge to Kalavryta, on the northern edge of Arcadia.

"Eis ton Megaspelæon?" [For Megaspelæon?] I inquired, as I looked into the already crowded combination car. (During my stay in Athens I had an English-Greek lady dictate 20 or 30 convenient phrases, which I had conned until I could utter them with some glibness.)

"Nai, nai" [Yes, yes], was the answer, and a youth of 20 crowded some rustics over so as to give me the best that could be had in the second-class compartment.

I tried to enter upon a conversation, but between my limited vocabulary and the strong reserve of the youth the attempt failed. However, as the train began to wriggle up one of the most picturesque valleys of the Peloponnesus, the youth showed he had not forgotten me by catching my arm and pointing to the unusually fine view as the mountain torrent burst through the sharply cleft rock.

WHAT IS THE RAILROAD ETIQUETTE?

Two enthusiastic young Greeks in the next seat also gave me some attention. They were from Athens, on a holiday

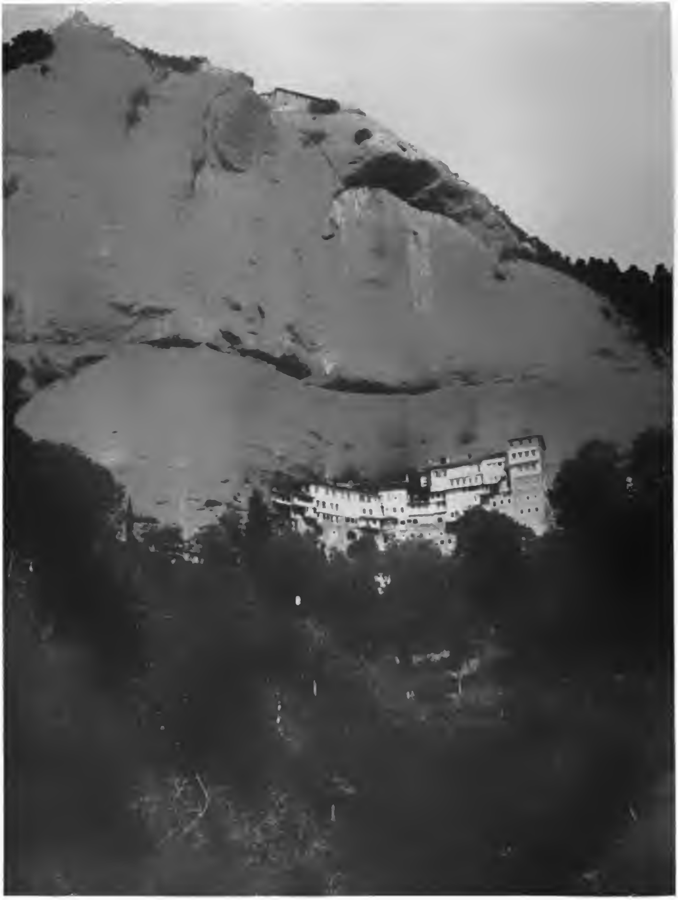

Photo by Carroll S. Alden

THE MONASTERY OF MEGASPELAEON SEEN FROM A DISTANCE, SHOWING THE VERDANT GARDENS AT ITS FOOT

"On retracing the path leading to the valley, I turned and caught my last glimpse of the monastery, in the distance no longer dirty and dilapidated, but thoroughly picturesque as it hung half way up the cliff like a huge swallow's nest" (see page 323).

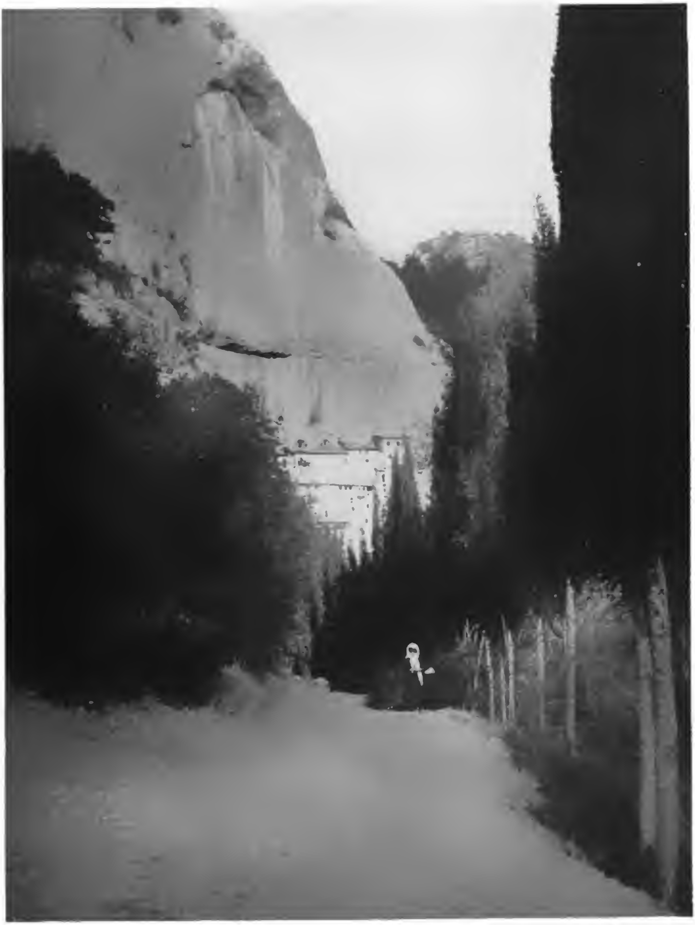

Photo by Carroll S. Alden

PATH LEADING TO THE MONASTERY OF MEGASPELAEON

"The monastery is 3,000 feet above sea-level, on the face of a large cliff. It rises out of a leafy bower and seems to be plastered against the bare gray rock of the mountain" (see page 315).

Photo by Carroll S. Alden

MONKS KILLING TIME AT THE ENTRANCE TO THE MONASTERY

"I could not help thinking what a miserable life is that of the monks of Megaspelæon. They send out no missionaries or preachers to the neglected people; they go through their services with considerable indifference; they have no interest in study; they write no books, nor do they, like certain orders in the Roman Church, care for the sick and the poor" (see text, page 323).

trip, and spoke a little French. Although my French is as uncertain as that of a girl at a boarding-school, we exchanged some ideas.

Later, as they opened a lunch-box, they offered me at intervals, first a sandwich, next an egg, later wine, grapes, and a pear. I began by declining, but the reserved youth at my side again manifested his interest in me. He had not been included in the luncheon party, but he plainly disapproved of my course of refusal. At each offer he would assure me, "Yes, good," and when I still refused, he became so earnest and insistent that I suspected that he was attempting to save me from a seeming discourtesy.

On leaving the train, I secured a donkey at a khan near by. The little beast proved of value, for the monastery is 3,000 feet above sea-level, in the face of a large cliff.

Soon I caught my first glimpse of the monks' home, apparently rising out of a leafy bower and plastered against the bare gray rock of the mountain. The winding path the donkey followed was not a little romantic, at times completely shut in by trees and shrubs, and later emerging and affording an extensive panorama. The tiny brook that crossed the path again and again, or the several brooks, I know not which, made pleasant music in a country where the soil is rocky and the rainfall slight.

HOW IBRAHIM PASHA OVERREACHED HIMSELF

The path as it approached the monastery became steeper and appealed strongly to the imagination; for this was the spot where the great Turkish commander, Ibrahim Pasha, had been kept so long at bay. During the war of independence, nearly a century ago, it was the monks from this vicinity who had first urged the people to throw off the hated yoke.

Naturally when Ibrahim Pasha had reconquered much of the Peloponnesus he thought in passing he would take the monastery of Megaspelæon and possess himself of its treasures; but the warlike monks, re-enforced by a few Pallikars, placed two cannon on the cliff above and effectually barred the progress of the Turkish army up the steep and narrow path.

However, Ibrahim, being a man of iron, was not to be thwarted. After spending some weeks in vainly trying to reach the monastery by the path, he sent a force which with great labor succeeded in gaining the heights above. One can fancy what then must have been the terror of the women and children who had taken refuge with the monks and the exultation of Ibrahim.

But a surprise came when his men began to roll down rocks from their vantage point and discovered that the monastery clings so closely to the overhanging cliff that the huge missiles fell wide of their mark. Doubtless as the boulders went crashing down the mountain-side they drove more than one startled and angry Turk to shelter.

A HOSPITABLE WELCOME

As I approached by the path, I came up directly underneath the monastery, whose huge wall rose 50 or 60 feet, with six stories of wood superimposed on this. A large bell rang to announce my arrival, and many a curious head peered down on me.

I slid off my donkey on reaching a platform before the monastery, and a lean, hungry-looking youth, bristling with a four days' beard, took my bag and led me up the stone steps into a building adjoining the monastery. The *Xenodochos*, a monk whose duty it is to provide entertainment for pilgrims and visitors, greeted me and soon had brought good cheer in coffee, Turkish style—muddy with pulverized grounds and very sweet. Most travelers are fond of it.

"*Anglos?*" he asked.

"*Ochi* [No], *Amerikanos.*" It was not a long conversation, but both of us were pleased at having exchanged an idea and by common consent lapsed into silence.

The large room into which I had been shown on arrival had eight coverless couches, which I supposed I was to share for the night with six Greek pilgrims, who had come to this their holy place. My supper was served in this room, but not with that of the pilgrims. I feasted in the august company of my own soli-

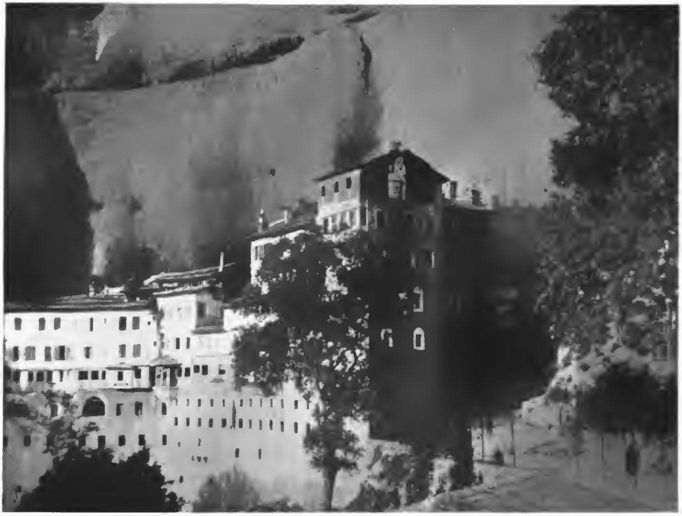

Photo by Carroll S. Alden

NEAR VIEW OF THE MONASTERY, SHOWING THE HUGE FOUNDATION WALL AND THE WOODEN STRUCTURES BUILT ABOVE IT

tary self, banqueting on lamb (pot roast), rye bread, ripe olives, goats' milk cheese, and red wine.

Later I was conducted to another and smaller building, placed over the monks' little terraced gardens, on the steep slope of the mountain. As I discovered, I was the guest of honor and had a whole house to myself.

HOSPITALITY A NECESSITY, NOT A VIRTUE

Hospitality is a virtue common to Greek monasteries, doubly to be appreciated since the inns are wretched and in the villages are often entirely lacking. This hospitality a century ago was not a virtue, but a necessity, for the monasteries had thus to satisfy the Turkish government to avoid being plundered. Happily the tradition persists long after the requirement has ceased.

The lean, unshaven youth who had first met me—he was not a monk, but acted as porter and kitchen boy—said something which I guessed to be the reassuring information that his name was Georgios, and that, having served as butler in an Englishman's family in Athens, he could talk English; the latter confidence he communicated with great pride.

I promptly hailed him joyfully as a gift of the gods, but our friendship was disappointing. Snobbishness, particularly in the wilderness, is not an American vice, yet I could not find that the ex-butler and I had much in common.

My objection to Georgios began early, as I inquired how many monks were then living at the monastery and received the answer, "Yes, oh yes."

"But how many, *how many*, monks are there here?" I asked, speaking very slowly.

"Yes, yes; oh yes."

I made one more attempt, reversing my question, and in conclusion asked if there were "50, 100, how many?"

He hesitated for a moment, looked

Photo by Carroll S. Alden

THE GUEST-MASTER, OR XENODOCHOS, WHO PROVIDES FOR THE ENTERTAINMENT OF STRANGERS

"The *Xenodochos*, a monk whose duty it is to provide entertainment for pilgrims and visitors, greeted me and soon had brought good cheer in coffee, Turkish style—muddy with pulverized grounds and very sweet" (see text, page 315).

Photo by Carroll S. Alden

THE MONKS' TERRACED GARDENS: THE BUILDING IN THE CENTER AFFORDS QUARTERS FOR THE HONORED GUESTS

"A British minister, Sir Thomas Wyse, who visited Megaspeleon in 1858, well characterized it as a 'great dormitory of religious [illegible]

Photo by Carroll S. Alden

MONKS WITH THEIR BREAD AND WINE: NOTE WINE-SKINS HANGING ON THE WALLS

puzzled, and I became hopeful as I saw calm following the severe mental effort; but his answer was the inevitable "Yes, yes indeed; oh yes, oh yes."

WHY A SLEEPING-BAG IS A COMFORT IN GREECE

The bed in the house assigned me had for covering a blanket and one sheet: the latter had grown gray with service, but it compared favorably with accommodations elsewhere; for outside of Athens and three or four other places frequented by tourists, beds in Greece have a bad reputation. Whether in hotel or in private house, they are commonly possessed by small devils. However, a light sleeping-bag I had with me kept out intruders, and I have only pleasant memories of slumbers at Megaspelæon.

The very atmosphere of the place is sleep, and with my windows flung wide, admitting the cooling breath of the mountain, I did not waken till 7 the next morning, when there resounded the pounding of a mallet on a heavy vibrant board—the summons to prayers.

It was Sunday morning, and the half dozen pilgrims who had spent the night at the monastery had been joined by 30 peasants from the country near by. The chapel, 30 or 40 feet square, was crowded near the door and the people were standing. This, the nucleus of the monastery, is, as of old, in a cave, only the chapel is so well walled in and roofed over that I did not at first notice the peculiarity of its construction.

A hundred candles were burning, and the richly jeweled hearts and the somewhat garish ornaments with which the altar screen and walls were studded caught up the gleams. The service to the stranger was dreary and monotonous, nor did the harsh, droning voice of the monk who furnished the music make it less so.

There is at Megaspelæon an object greatly venerated by all devout Greeks, a painting almost black because of its age

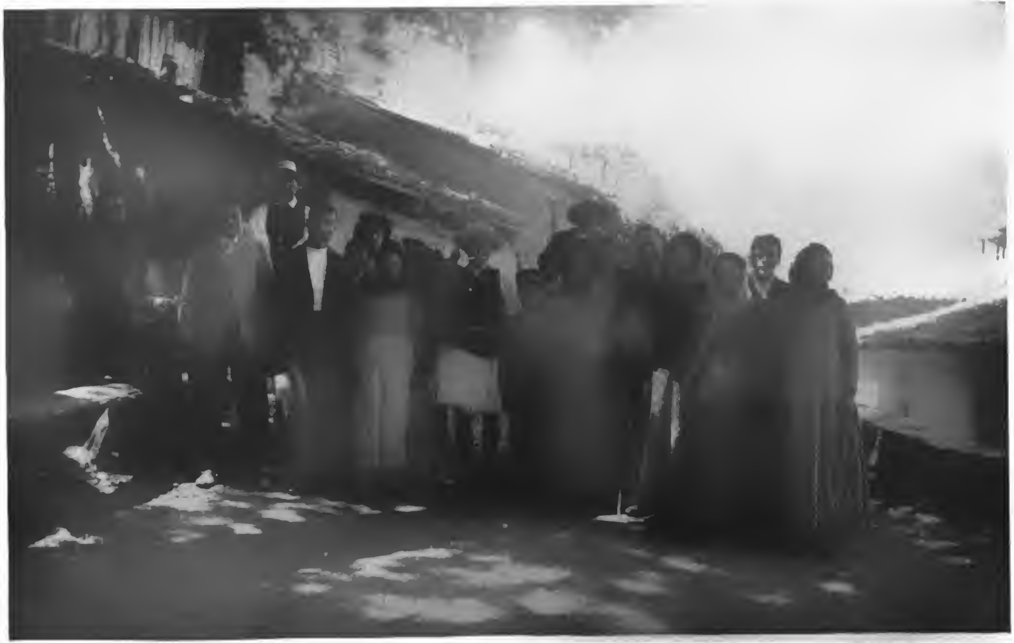

Photo by Carroll S. Alden

A GROUP OF PILGRIMS AND PEASANTS AT MEGASPELEON: NOTE THE NATIVE COSTUME OF THE PEASANT IN THE CENTER OF THE GROUP

"After breakfast I gathered the pilgrims and people who had come up for the morning service for a picture. Most of them were as pleased as children, and they joked and jostled one another as they took their places, as any American holiday crowd would do under the same circumstances." (See text, page [illegible])

Photo by Carroll S. Alden

A MONK RETURNING FROM WORK ON THE MOUNTAIN FARM

and its exposure for centuries to smoky candles. It is of the Virgin and Child, and is ascribed to Saint Luke, for tradition says that Luke was a painter as well as a physician, and that this picture he made from life.

Some of the Greeks affirm that the images in this marvelous picture spoke plainly to them during the war of independence, weeping at times of defeat and encouraging them with the promise of ultimate victory. It is certain that the painting is very old; Murray in his Handbook dates it from the 8th or 9th century.

After the service a man whose duties were about the same as Georgios' showed me over the monastery. As he was not an accomplished linguist like Georgios, we got on well together. He understood my explanation of what my camera was for, and he took me down long passages, dark as night, past the monks' cells, up a crazy, creaking stairway that uttered a long complaint of old age and weariness, until we reached the very top.

A young monk who had one of the better rooms happened to pass, and my cicerone induced him to play the host. Dionysos (the young monk had the most pagan name) was scarcely more than a boy, perhaps 17, and his beard—the invariable sign of the Greek priest and his chief pride—was just beginning to appear. His cheeks were thin and lacking in color, and his long hair gave him almost a feminine appearance. His countenance expressed, as I fancied, something of sadness and disappointment, but as I told him I wanted a picture of him and his room it lighted up responsively.

I saw him for only a few moments, but if the first impression is to be relied on the lad possessed rare qualities; he needed only inspiration and a great purpose to bring them out.

THE WINE TUNS OF THE MONASTERY

Having been to the summit of the monastery, we next proceeded to the very depths, catching a glimpse in passing of the library, a small room with one

Photo by Carroll S. Alden

DIONYSOS IN HIS CELL

gloomy window, as I judged but little used; but if the monks have nothing of a library it may be remarked that books and learning are not their specialty. After groping along a pitch-dark passage we descended into a huge, cobwebby cavern in the mountain, where water was dripping in a dozen places from the rock ceiling and the sides.

Here I saw what certainly could not be regarded as commonplace, for there were gigantic tuns of wine that would have been a credit to Heidelberg. It is in their wine cellar that the monks of Megaspelæon excel, and as I watched two monks who had brought the pilgrims down here and heard them explaining what I could easily guess was the extraordinary capacity of the tuns and the excellent quality of the wines, I observed a flash of pride and enthusiasm such as nothing else had elicited.

On the stairs we had met the keeper of the cellar—a rough, square-built fellow—carrying on his shoulder a wine-skin which he had just filled and was taking up for the morning's distribution. In the hall above, where there hung a row of 15 or 20 wine-skins, old and new, the wine was doled out, each monk receiving his pitcher full and also a loaf of rye bread.

The Greeks eat scarcely half what the northern European nations require. The 11 o'clock breakfast was the first meal of the day, and at the monastery consisted of the same articles as I ate for supper the preceding evening. While for this vicinity it was a sumptuous repast, it would have seemed like Spartan simplicity to a hungry German.

When breakfast was about to be served I made a move to join the pilgrims at a large table, for I sought intimate acquaintance with their life. But no, the *Xenodochos* was a stickler on class distinction, and again I had a room and a table all to myself, where I might eat with great dignity and loneliness.

CLASS DISTINCTIONS AND PHOTOGRAPHY

After breakfast I gathered the pilgrims and people who had come up for the morning service for a picture. Most of them were as pleased as children, and they joked and jostled one another as they took their places, as any American holiday crowd would do under the same circumstances. But again I ran counter to prejudices based on class distinctions; three women, somewhat better dressed than the others, together with the aristocratic Georgios, unmoved by my exclamation, "*Photographia!*" refused to be taken with the peasants. However, they were not nearly so interesting and picturesque as their humbler countrymen, and their absence meant no loss.

It seems almost ungrateful for one who has enjoyed the hospitality of the monks of Megaspelæon to speak a word in criticism, yet if the truth be told they are an idle lot and have a bad reputation for honesty.

A striking commentary on the place and the people is that I found each of their little terraced gardens strongly hedged in or fenced off from the main path and from the neighboring gardens. They were to be entered only by gates and the gates were padlocked. Similarly, even in remote parts of the monastery, the rooms were securely locked. What must be the conditions when the faithful have to take such extreme care to guard their possessions from their own number!

THE NEGLECTED STATE OF MEGASPELÆON

Further, the shabby, neglected state of the monastery gives the visitor an unpleasant impression. A century ago, when the monks were under the scrutiny of the Turks, there was reason for their simulating poverty; but now the ruinous condition of their main building, in sharp contrast to their reputed wealth, gives their indifference the character of sacrilege.

A British minister, Sir Thomas Wyse, who visited Megaspelæon in 1858, well characterized it as a "great dormitory of religious commonplace, sleeper succeeding to sleeper." Their building may be taken as an index of the general life of the monastery; all is today much as it has been for centuries, while the sun, the rain, and the winter storm have slowly carried on their work of destruction, making no slight havoc on the miserable wooden upper structure, in the repair of which the inactive monks have employed only the merest makeshifts.

On retracing the path leading to the valley, as I turned and caught my last glimpse of the monastery, in the distance no longer dirty and dilapidated, but thoroughly picturesque as it hung half way up the cliff like a huge swallow's nest, I could not help thinking what a miserable life is that of the monks of Megaspelæon. They send out no missionaries or preachers to the neglected people; they go through their services with considerable indifference; they have no interest in study; they write no books, nor do they, like certain orders in the Roman Church, care for the sick and the poor.

What a living death! Dionysos' pallid face, his sad, yearning expression, and his quick hungry response to a few words of interest still linger in my memory.

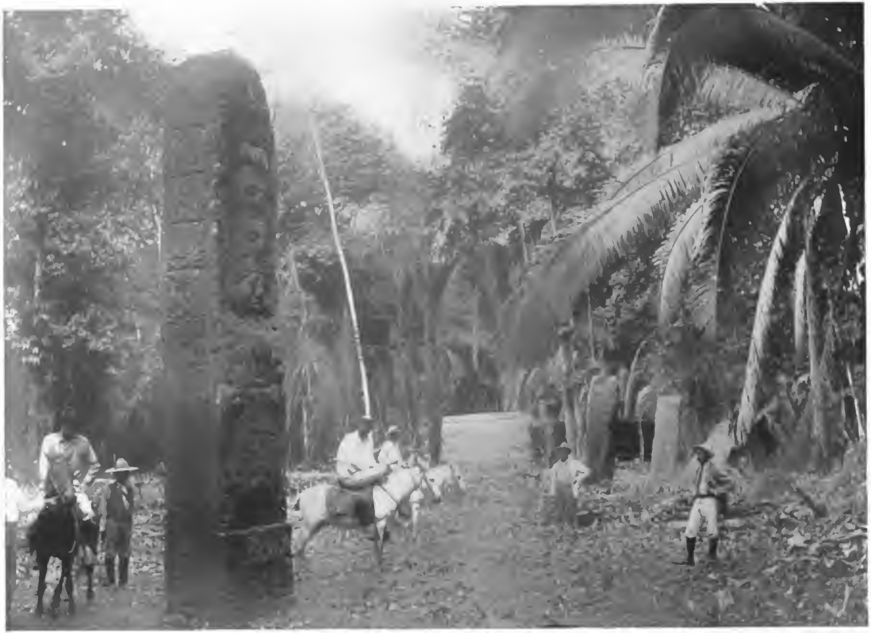
Photo by Valdeavellano & Co.

THE AVENUE OF MONOLITHS AT QUIRIGUA

"Through the arches of the palms suddenly appears a group of mounds, still overgrown with masses of foliage, and beyond these an avenue of great stones, carved monoliths, leading to some—as yet—invisible altar or temple. From each pillar stares—impassive, gloomy, or sullen—a gigantic face" (see text, page 331).

MYSTERIOUS TEMPLES OF THE JUNGLE

The Prehistoric Ruins of Guatemala

By W. F. Sands

Formerly American Minister to Guatemala

WITH the opening of the Quirigua ruins in Guatemala a most important addition is being made to the material now available for study of the races which once occupied the low, hot coast land between Copán, in Honduras, through the Guatemala littoral, Petén, and Quintana Roo to Yucatan.

Master races they were as were once the Brahmans in Indo-China. They conquered in easy battle the fever-ridden natives, and lived thenceforth upon the country and its population.

They taught them nothing of their higher civilization, but ground them back to the earth, until inbreeding, idleness, and fever took their toll, and in their turn they were overthrown and perished, leaving nothing but the elaborate monuments and massive buildings which, covered with the mould of centuries of quick springing and quick decaying tropical forest, form the "Indian mounds" so plentiful in this region.

A RACE OF PRIESTLY CONQUERORS

The theory of an alien sacerdotal aristocracy, claiming divine descent because of superior development, and ruling an untutored conquered race, while it offers no suggestion as to origin, may at least explain why no memory of their rule remains among the inhabitants of these regions today. Knowledge of every kind was kept from the subject races, and with the downfall the slave fled from the ancient holy places, and the symbols of arrogance, cruelty, and power were shunned for centuries as an abomination.

It is not necessary to hold with Brasseur de Bourbourg that all these countries (the "Hinterland" of Atlantis) were submerged when the island-continent was destroyed, although his theory is immensely attractive, and that after remaining under the sea for an unknown period they rose once more and were peopled from the highlands.

It is simpler to imagine, as long as we have nothing definite to go on and one man's tale is as good as another's, that some such catastrophe took place as is so charmingly suggested in Sir Hugh Clifford's "Tragedy of Angkor," and that the degenerate rulers of the coast were shown suddenly to their subjects by some attack of the hardier mountain tribes to be no longer irresistible, no longer divine, but only very feeble men, and so were wiped out as utterly and effectually as would have been the first weak settlement on our own shores without succor from the mother country.

AN ENVOY WHO FAILED TO FIND HIS GOAL

Perhaps none of the ruins of America is more accessible now to Americans than those of Quirigua; and yet, though frequently visited, they are among the least known.

John Stevens, in his gossipy "Travels in Central America, etc.," in 1839, has left an excellent account of both Quirigua and its neighbor, Copán, during his wanderings in search of a Federal government sufficiently stable to receive his credentials as American Minister.

Failing in the object of his official mission, he returned north through the Guatemalan highlands, visiting also the ruined cities of Quiché, and so up the ridge of the Cordillera, through Chiapas to Palenque and down to Chichen, Itza, and Uxmal, in Yucatan—a wonderfully beautiful journey and not in any way difficult for a saddle-hardened rider.

Stevens left a valuable record; but his real treasure (aside from the personal reminiscence of the astonishing Carrera, who from a particularly brutal swineherd became a demi-god and one of the ablest rulers Guatemala has known) is the series of admirable drawings by Catherwood, who accompanied him, of all the monuments in both Quirigua and Copán, which remain unexcelled even by photography.

Photo by Valdeavellano & Co.

THE BEAUTIFUL SITUATION OF QUIRIGUA

"The ruins lie on low, flat land, flooded and renewed each rainy season by the Motagua's overflow—rich, inexhaustible alluvial soil, and ideal for banana-growing. A more inspiring spot can hardly be imagined. Under the immense ceiba and other coast trees (70 and 80 feet to the lowest branches, each as big as a 30-year maple and hung with orchids or Spanish moss) has grown up a thicket of palms and fern trees, forming, when the underbrush is cleared, arching forest galleries impossible to describe" (see text, page 331).

Many travelers have passed through since the completion of the railway; but, with the exception of Maudslay, none has attempted to give more than such a description as I am now writing. At present all men are equal, for no one has succeeded in deciphering the historical writings of Quirigua.

THE SITE OF QUIRIGUA CLEARED

In the spring of 1910 the tract of land surrounding the monuments, on the left bank of the Motagua River, was opened for planting by the United Fruit Company of Boston, and a park left about the principal ruins. The company generously supplied labor and many other facilities for clearing this park of underbrush and cleaning the stones, so that at last an organized study was made possible, under the guidance and supervision of Prof. Edgar L. Hewett (Director of the School of American Archeology, at Santa Fé, New Mexico) and of Mr. Sylvanus Griswold Morley (see article by Mr. Morley, pages 339 to 360).

Both of these gentlemen have spent many months in exploration and detailed examination, and under Mr. Hewett's able direction the institute has an opportunity for study hardly paralleled in the history of American archeological research.

Quirigua should become the starting point, the workshop, and the school for beginners in this branch until the gradual

Photo by Valdeavellano & Co.

GREAT BANANA TREES NEAR QUIRIGUA

These banana trees grow to the height of 40 feet, attaining this growth in a period of 18 months. So rich is the alluvial soil of the plain upon which Quirigua stands that the vegetation here grows at the incredible rate of one-half inch every 24 hours.

development of the country makes organized extension possible into Petén without the hardships and risks to health and life to which sojourners in that beautiful but treacherous country are now subject. Quirigua is free from all these drawbacks, and nothing could be easier than its approach.

The steamer that brings the traveler from New Orleans is only one entire day out of sight of land. The run down the Mexican coast and along the cays and islets of British Honduras is beautiful, with tiny villages white against the forest line and the "Cockscomb" jagged range stretching blue in the distance. From Belize, the capital of the crown colony, it is only a few hours to the Guatemalan border and to the mouth of the Rio Dulce.

This historic waterway (Cortez' road on his superhuman raid from Mexico City to the Honduras coast) opens deep between miles of high wood-hidden cliffs into a vast tide lagoon stretching 30 miles toward the mountains of Vera Paz, "The Land of True Peace" of Las Casas, conquered by him and his Dominican friars when years of fierce fighting had resulted in unvarying disaster and defeat to the Spanish troops at the hands of the warlike Indians.

WHAT THE COAST TOWNS ARE LIKE

Livingston, a Carib town, lies clean and white on a low bluff at the entrance bar, and just opposite, a few miles away by sea, is the real port (Puerto Barrios) more important, but far less sightly, than its neighbor.

Livingston receives the coffee trade from the German plantations of Vera Paz, does a bit of "free trade" on its own account, filibusters and fishes. The soul of the Spanish Main still lives there, and all the game fish of Tampico or Catalina Island are to be found about Puerto Cortez, the next little town, beyond the Motagua River in Honduras, or in the great lagoon above the shady stretches of the Rio Dulce.

Puerto Barrios has a railroad terminal, tank and turn-table, a customs shed, a group of buildings belonging to the United Fruit Company, a barrack for a half company of Carib infantry, and a rotting wooden hotel, all set in a swamp, bridged from house to house by board walks, and made altogether unendurable by mosquitoes. Fortunately one is not obliged to remain in this singularly unattractive place, for the daily train to the capital starts as soon as the passengers are through the customs, and, long before the sun is high, has plunged into a jungle so thick that a dozen paces from the railroad embankment the sun is invisible.

This dense brush is filled with game: the small deer common to America and Asia, herds of peccary (the small wild pig always cited as a model of fierceness in all the good old books of travel and adventure of our boyhood), tapir, an occasional jaguar, and birds of all kinds, some related to our own game birds.

Monkeys were common enough, but the natives say that they died by the hundred, not a great many years ago, of smallpox. I do not vouch for the diagnosis, but I always visit the jungle with a receptive mind.

A few miles beyond this forest primeval villages begin to line the track, which now follows the Motagua River; groups of huts built of four walls of split bamboo stems set upright in the earth, with a floor of split bamboo laid cross-wise and a roof of palm-leaf thatch; some of them are set on the damp and soggy ground and some slightly raised to allow for drainage.

Among these appear others more tidily and securely built of whitewashed plank, inhabited by negroes who come here from the West Indies, Belize, and our own Southern States, attracted by the good pay offered by the fruit company and the railroad. A fair sprinkling of escaped criminals and "bad men" from New Orleans gives to all our American negroes an undeservedly evil reputation on the coast.

THE GREAT BANANA PLANTATIONS

These villages cultivate a little corn, a little fruit, and some gaudy flowers about the huts; but in spite of any attempt at neatness or decoration, they convey only a strong impression of impermanency. Along this part of the river

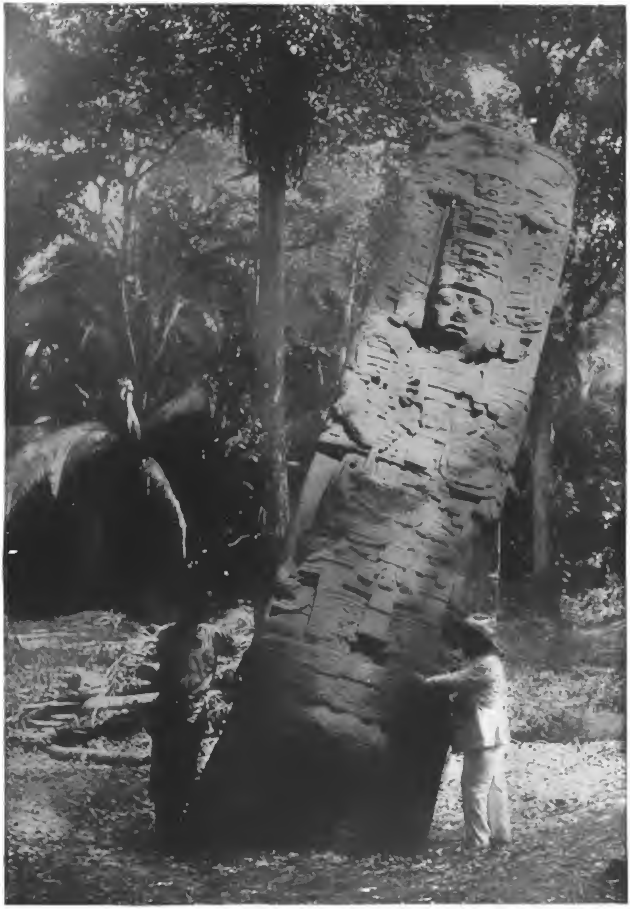

Photo by Valdeavellano & Co.

A FALLING MONUMENT

These great monoliths, some of which are as much as 26 feet high, were quarried from the foothills two miles west of the city, and were probably transported thither on rafts during the rainy season, when the greater part of the valley is submerged by the overflow of the Motagua River (see text, page 354).

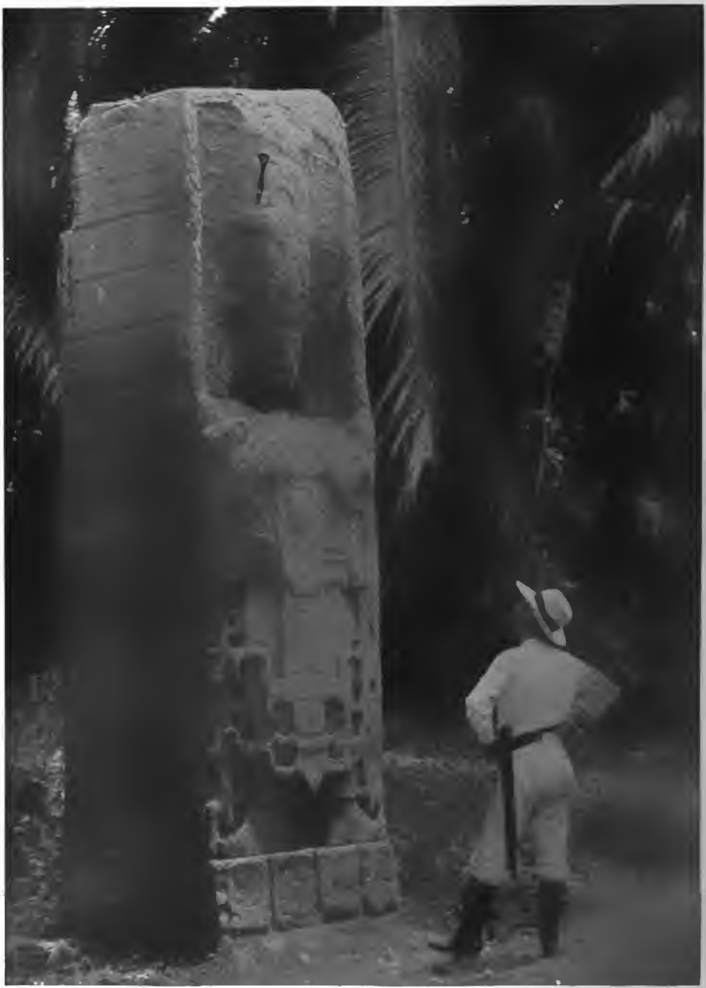

Photo by Valdeavellano & C

WELL-PRESERVED HIEROGLYPHICS

"Each figure is crowned with a tall feather head-dress; is belted with a short embroidered skirt like the sacrificial apron worn by Korean eunuchs in the Heaven sacrifice—naked, with heavy ornaments at wrist and ankle. On the sides of the stones are columns of glyphs, until now undeciphered, but nearly all plain and well preserved, and, when the clue shall have been found, easily legible" (see text, page 331).

between the bank and a ridge of hills, covered partly with tropical growth and partly with sickly pines, the banana plantations of the Boston company cover 18,000 acres, mostly developed in the last five years.

In place of the jungle belt, through which I passed on my first visit to Guatemala, are well-ordered sections or "farms" tapped by spur lines of the railway, each fed in its turn by Decauville roads. Each farm is overlooked by the superintendent's house, built like those designed for the Panama Canal workers, well above the ground, with broad porches, screened and mosquito-proof.

The company has of late preferred young college graduates as farm superintendents, and the station name often indicates the founder's school. In the center of all, set in a too-luxuriant rose garden, surrounded by labor villages, shops, storehouses, offices, and "bachelors' quarters," lies the big, comfortable house of the young manager, under whom this extraordinary growth has been attained.

A few miles beyond, 57 from Puerto Barrios and 2½ from the railroad, toward the river, lie the ruins of Quirigua, from the beginning of last year open country like that below, planted with banana "eyes" like a vast potato field, with a lively camp of some 1,800 laborers preparing still more acres.

THE BEAUTIFUL SITUATION OF QUIRIGUA

The ruins lie on low, flat land, flooded and renewed each rainy season by the Motagua's overflow—rich, inexhaustible alluvial soil, and ideal for banana-growing. A more inspiring spot can hardly be imagined. Under the immense ceiba and other coast trees (70 and 80 feet to the lowest branches, each as big as a 30-year maple and hung with orchids or Spanish moss) has grown up a thicket of palms and fern trees, forming, when the underbrush is cleared, arching forest galleries impossible to describe.

From the ceiba and mahogany trees drop long, leafless, snake-like black vine stems—one, the "water-vine," containing a quart of clear, pure water to every foot, which spurts forth in a refreshing stream when cut. It is a real, thirst-quenching water, drawn up from the soil and filtered through the pores of the plant; not a sap, as one might suppose. As is generally the case, this vine grows thickest where the surface water is least drinkable.

Through the arches of the palms suddenly appears a group of mounds, still overgrown with masses of foliage, and beyond these an avenue of great stones, carved monoliths, leading to some—as yet—invisible altar or temple. From each pillar stares—impassive, gloomy, or sullen—a gigantic face. Each figure is crowned with a tall feather head-dress; is belted with a short embroidered skirt like the sacrificial apron worn by Korean eunuchs in the Heaven sacrifice—naked, with heavy ornaments at wrist and ankle.

On the sides of the stones are columns of glyphs, until now undeciphered, but nearly all plain and well preserved, and, when the clue shall have been found, easily legible. The faces are well carved, of a heavy, full type, with thick lips, narrow eyes, and thin, carefully pointed Egyptian beards, like the Sargent Pharaoh in the Boston library. Several show a remarkably cruel strength, which lessens with each set of pillars to a weak, purposeless, degenerate type—loose-lipped, chinless, and imbecile. Among them is to be found the most perfect pieces of carving I have yet seen among American antiquities (see pages 333 and 342).

CENTERS OF A GREAT CIVILIZATION

It is not to be supposed that either this place or Copán was an isolated group of temples. It is more likely that they were centers, and that more similar, if less perfect, remains will be uncovered in the near future in the course of deforestation preliminary to banana planting.

There is no reason to suppose that the aboriginal dwelling was in any way superior to the bamboo and thatch structures I have described above—than which nothing could well be more perishable. The Motagua Valley and adjacent territory may have been and probably was densely populated about these sacrificial foci; but with the overthrow and savage

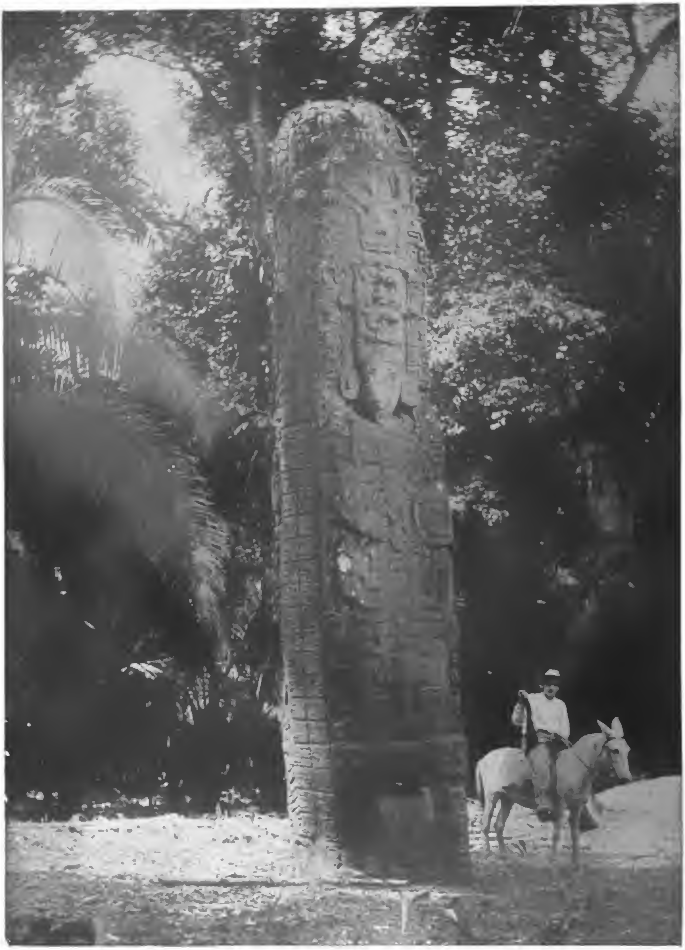

Photo by Valdeavellano & Co.

A MAYA CALENDAR

At the close of each hotun, or 1800-day period, at Quirigua, one of these monuments was erected. The hieroglyphics carved on the sides probably record the principal events of the corresponding period in each case.

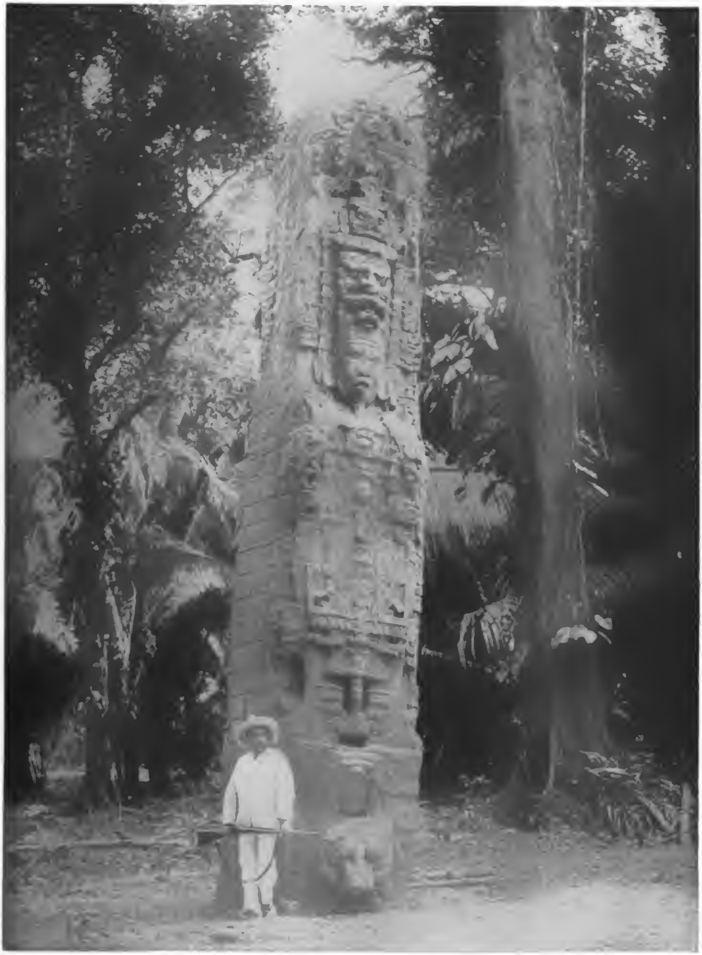

Photo by Valdeavellano & Co.

THE CURIOUS EGYPTIAN TYPE

"The faces are well carved, of a heavy, full type, with thick lips, narrow eyes, and thin, carefully pointed Egyptian beards, like the Sargent Pharaoh in the Boston library. Several show a remarkably cruel strength, which lessens with each set of pillars to a weak, purposeless, degenerate type—loose-lipped, chinless, and imbecile" (see text, page 331).

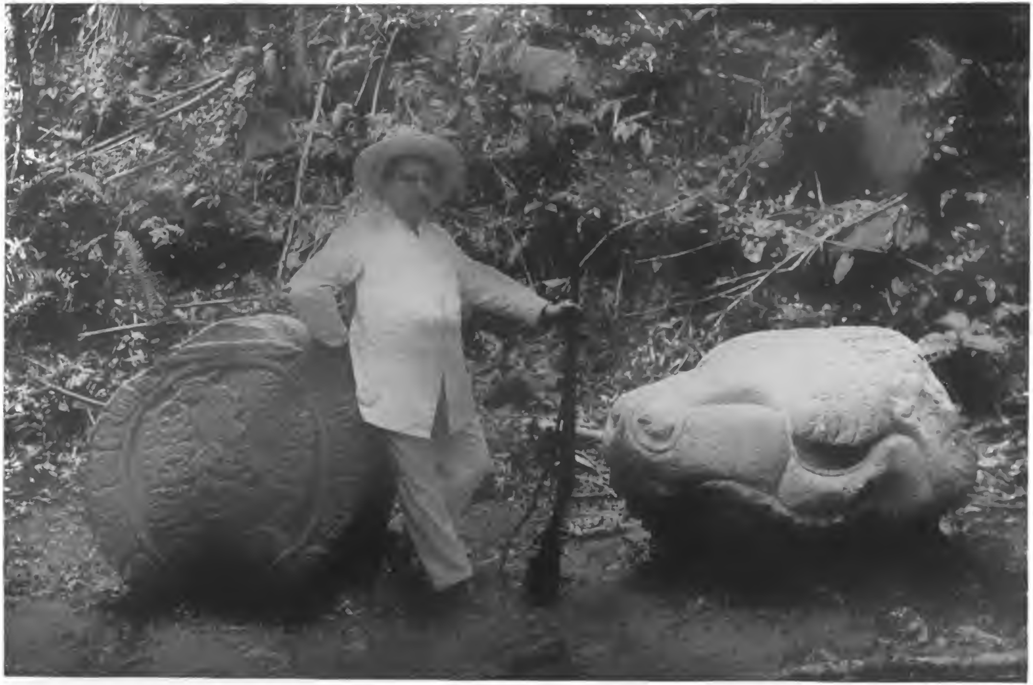

Photo by Valdeavellano & Co.

TWO INTERESTING FRAGMENTS

The disc to the left shows a figure in profile which bears a strongly marked resemblance to the types we are familiar with in the ancient [illegible] annihilation of the last of the priest-kings and the flight of their emancipated but terrified subjects to the higher valley of the same river about Gualán and Zacapa, no trace would remain of any but the most substantial buildings, the temples and palaces. "Indian mounds" are frequently reported in all this region and have been known for many years to the adventurous spirits who have prospected for gold, railroads, mahogany, game, or "treasure" in these uninhabited forests.

These lie, according to such statements, along the river and in the hills toward the Rio Dulce and the lagoon, with a general trend from Copán to Petén. Some lie in the upper Motagua Valley as far as the foot-hills above Zacapa. The railroad crosses the Motagua a few miles above Quirigua, forced to the right bank by the line of low hills it has followed from the coast.

Almost from the crossing the country begins to change. It becomes less swampy; the river bed grows rocky and no longer flows through deep banks of black earth; it acquires the greenish tinge of mountain streams; and the foliage on the banks, while not less thick, is drier and shows a less feverish green.

Above Gualán (perched picturesquely on a hilltop) the valley opens into a rainless, dusty, cactus-grown plain like northern Mexico or Arizona, surrounded by high bare mountains and watered by two fine rivers—the Motagua still and an affluent, the Zacapa. It is well populated; corn and cotton grow well, and cattle appear to prosper.

Yellow fever, having once got a hold upon this region, has become endemic, but I know of no place whence it might more easily be banished, and, cleaned thoroughly, these towns should be as healthy as any.

The inhabitants are of the "Ladino" class, the Spanish-Indian hybrid, which has, in the course of centuries, become a fixed type. They have a good idea of the possible value of their land, dry and dusty as it is, and will not sell at any price; nor are they in error. Barrage and pumping works installed in the Zacapa River—far beyond the power of native capital, it is true, but of easy construction for some American syndicate—would make of this plain the richest sugar region in the world. Cane needs heat and unlimited water, but neither wind nor rain. The burning Zacapa plain is sheltered from both, and has an inexhaustible supply of water from the rivers.

A PREHISTORIC MINING CENTER

There is every indication that this region was once as thickly peopled as any part of the country. Records of the missionaries who came after the Spanish conquest tell of large towns here and flourishing villages, and it may be that gold or silver workings gave to the overshadowing range the name it bears, of "Mountains of the Mines." Whether or not this upper valley of the Motagua was peopled from below might still be determined from the relics which remain.

These investigations, however, should be undertaken promptly before the development of all this country by investment of American capital and intensive cultivation has so altered its face that all record is lost. A connection between the upper and the lower Motagua Valley—that is, between the Zacapa Valley and the coast—seems to me to be more logical and natural than a relation between this region and the highlands.

Of the plateau cities destroyed by Alvarado sufficient record is still available to make comparatively easy an exhaustive study of the Quiché, Kakchiquél, and other tribes or nations of the mountains and of the Pacific coast. Rulers and people seem to have been of the same stock, and after their overthrow by the Spaniards and their Tlascalan allies, the survivors did not disappear; they rose again and again and fought their conquerors as long as there remained a chief to lead them.

DO THE INDIANS PRESERVE THEIR TRADITIONS?

The traditions of the ancient people, their religion, and their feeling of nationality may still live in the heart of the Quiché Mountains, and might be easily studied by one who would devote a num-

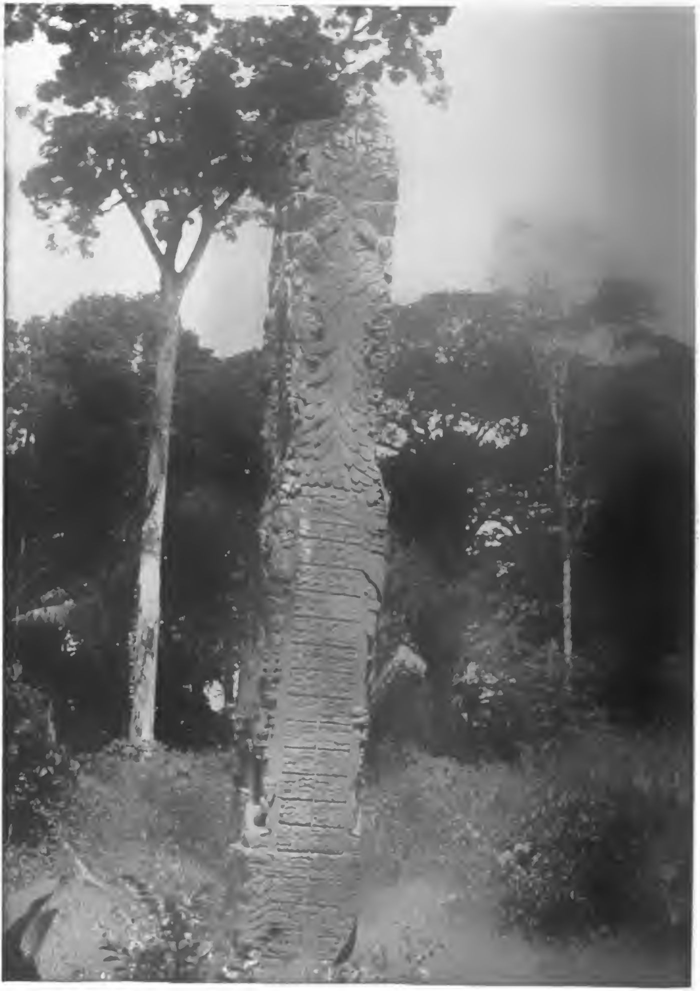

Photo by Valdeavellano & Co.

THIS MONUMENT, STELA F, IS ONE OF THE MOST BEAUTIFUL OF ALL THE HOTUN-MARKERS AT QUIRIGUA

It is 25 feet high above ground and is elaborately carved from top to bottom. It records the date 9.16.10.0.0.1 Ahau 3 Zip of Maya chronology, or approximately 490 A. D.

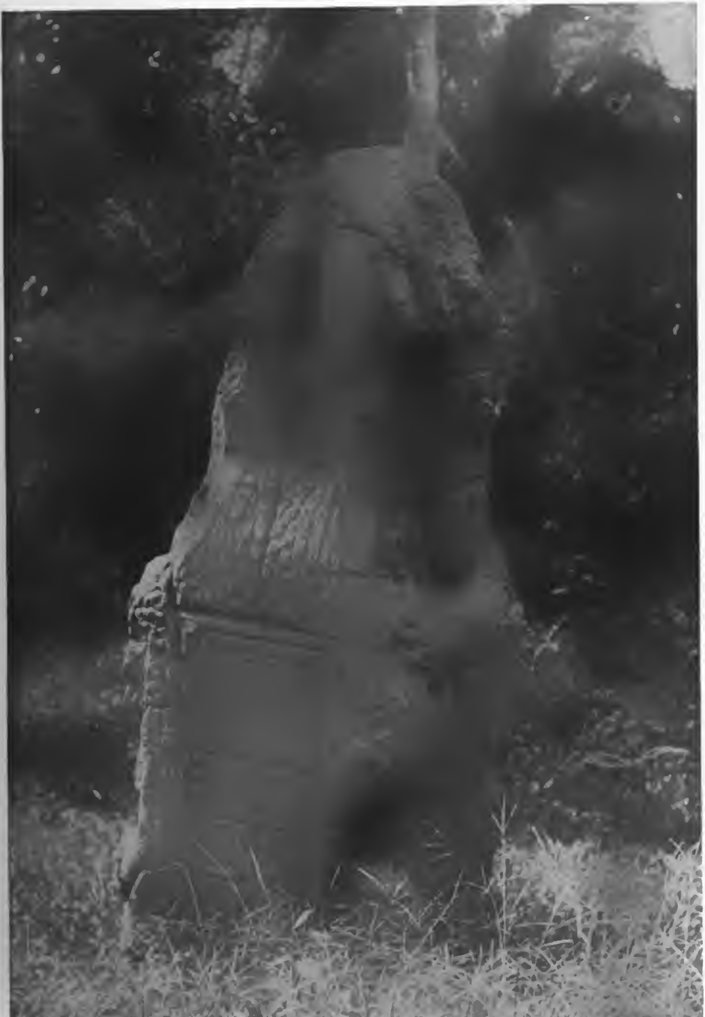

Photo by Valdeavellano & Co.

SIDE VIEW OF THE MONUMENT CALLED STELA K

The hieroglyphic inscription shown here records the date 9.18.15.0.0.3 Ahau, 3 Yax of Maya chronology, or approximately 535 A. D. Stela K was the last of the great monuments to be erected at Quirigua, the following hotun, or 5-year period (540 A. D.) being marked by the erection of Temple A.

ber of years of his life to acquiring their language and observing their customs and their prejudices, and who would make it his first care to treat them like human beings rather than savages (which, distinctly, they are not), or like beasts of burden. They are not emancipated yet from their martyrdom of centuries; since Bartolomé de las Casas they have had no protector. The republic has done nothing for the Indian, yet they are the finest stock in the country and in them lies the future of Guatemala.

To help him the student will find many treasures in the government archives and valuable historical documents in private collections. Much has found its way out of the country, and it is to be hoped that it is in the hands of some one who will realize the importance to history of these old manuscript books and records and will give it to the world.

The climate during the dry season (on the high plateaus, from October or November to March) is delightful; the high mountain valleys, pine and corn clad, with their soft-toned, well-shaded villages and towns; the true hospitality and gentleness of the people (once one has gained their confidence and affection) make an ideal setting for a winter's work.

The roads are only navigable for bullock-carts, it is true, but a mule or a good native pony will pass anywhere, in spite of bottomless ruts and spring holes. With a good animal, road traveling in Guatemala is, in my experience, unsurpassed for beauty except by the mountain paths of Korea.

There is also a dry season on the coast of which advantage may be taken, and will be taken, I hope, for several years to come, to complete the Quirigua work. When the mud has dried and the ever-vigorous underbrush has been cut from the park surrounding the monuments, a few weeks spent among them is not only not dangerous, but not unpleasant and would certainly be immensely profitable.

EXPLORING, BUT IN TOUCH WITH CIVILIZATION

As I have attempted to point out, the student is not lost in primeval jungle, but works near a camp which is the center and headquarters of the United Fruit Company's operations. He has but to follow their axemen every morning as they open new territory, and is at all times within easy range of tobacco, clean linen, magazines, good food, and, at the worst, of pills, American doctors, and hospitals.

With the coöperation of the government of Guatemala lies open to the Institute a work of vast importance to American archeology, under conditions—I was about to say—of luxury, and I think that the expression is well justified if comparison be made with any other American work of this character.

Nothing should be spared, in funds or men, to make Mr. Hewett's undertaking a complete success and establish the work in Guatemala upon as permanent a basis as that of San Juan Teotihuacan, in Mexico.

EXCAVATIONS AT QUIRIGUA, GUATEMALA

By Sylvanus Griswold Morley

Assistant Director Quirigua Expedition, 1912

THE ruins of Quirigua are located in the Republic of Guatemala, Central America, 57 miles from the Caribbean Sea. The heart of this ancient city, its civic and religious center (see map on page 349), covered about 75 acres, surrounding which on every side for a distance of several miles were the dwellings of the common people.

Quirigua was one of the older centers of the great Maya civilization, which flourished in southern Mexico, Guatemala, and northern Honduras during the first 15 centuries of the Christian Era. Judging from the dated monuments (see page 337) which were erected in its several courts and plazas, this ancient American metropolis was abandoned during the first half of the 6th century A. D.

Toward the close of the 6th century the Mayas moved out from the older centers of their civilization in the south and migrated northward into Yucatan. Here in the stress of colonizing a new and unfamiliar land the remembrance of their former homes gradually faded, until Quirigua, along with many another southern city, became only a memory, a tradition. Finally, long before the discovery of America, even the tradition of its former existence had passed from the minds of men.

QUIRIGUA LOST FOR CENTURIES

Hernando Cortez, the conqueror of Mexico, must have passed within a few miles of Quirigua in 1525, on his memorable march to the Golfo Dulce, but he

Photo from Sylvanus G. Morley

THE FIRST STEP IN EXCAVATING TEMPLE A WAS TO REMOVE THE SURFACE STONE

A line of native workmen are here shown passing the fallen building blocks down to the dump car. An assistant stands at the car to see that no sculptured stones are thrown away

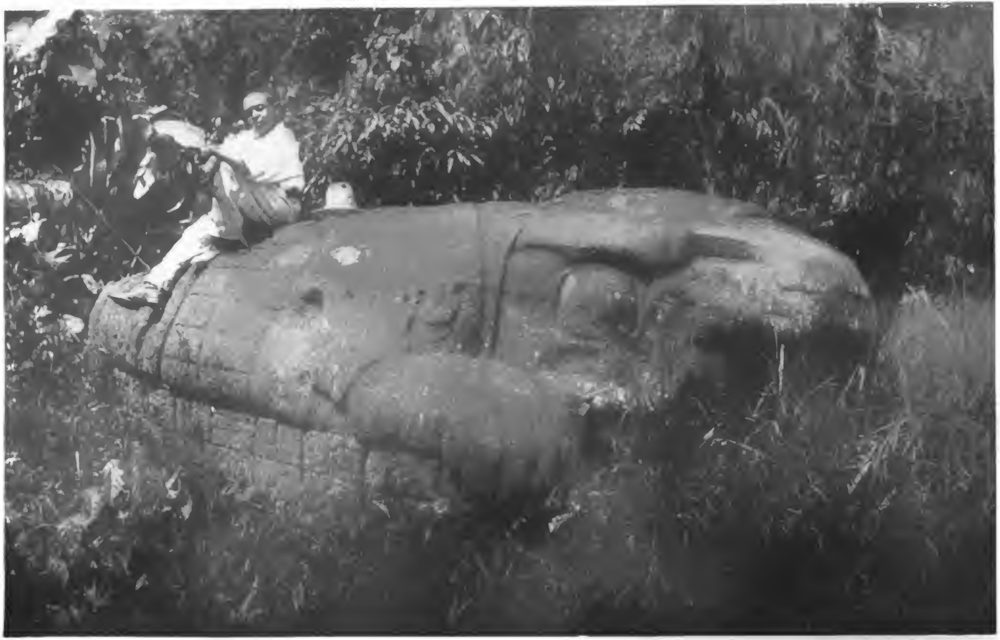

Photo by Valdcavellano & Co.

THIS MONUMENT, KNOWN AS ZOOMORPH G, REPRESENTS THE JAGUAR, OR AMERICAN TIGER

The bulging eye, yawning mouth, and clawing fore-leg appear very clearly in the accompanying photograph. The jaguar plays a very important role in Maya mythology, and its skin was extensively used as a priestly vestment. Priestly figures, with jaguar skins hanging from their shoulders, are represented in bas-reliefs from every part of the Maya area.

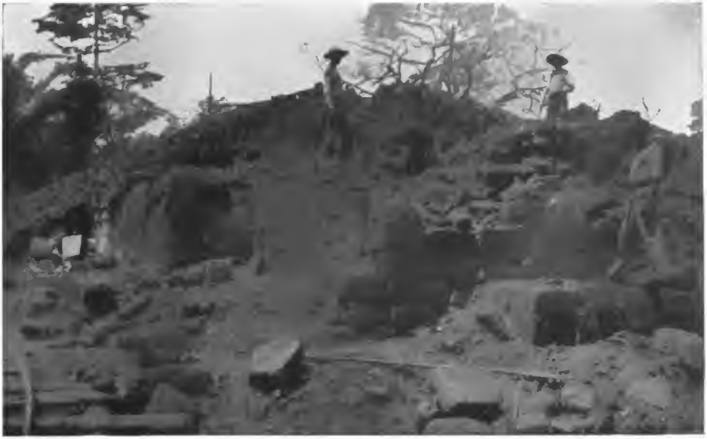

Photo from Sylvanus G. Morley

EXCAVATING TEMPLE A

Exposing the southeast corner after it had been buried for more than 15 centuries

makes no mention of the fact, and it was not until over 300 years later, or in 1840, that the site was again made known to the world by Stephens and Catherwood.*

During the centuries which had elapsed since its abandonment a dense tropical vegetation (see page 348) had overgrown the city, overthrowing its temples and palaces and reducing them to shapeless mounds of fallen masonry.

The jungle had won its way into the different courts and plazas; and these public squares, once teeming with the life of a populous community, had become the haunt of the tiger, peccary, monkey, ant-eater, and the infinite host of the tropical forest. The jungle had again reclaimed its own.

In 1909 the United Fruit Company, incidental to the purchase of a large tract of land in this vicinity for a banana plantation, acquired title to the site, and in the following year, through an arrangement with the School of American Archeology, the systematic study of the ruins was undertaken under the direction of Edgar L. Hewett.

DIFFICULTIES IN CLEARING THE SITE

The archeological investigation of Quirigua presented many new and difficult problems. Before digging could be commenced, it was first necessary to fell the all-enveloping jungle.

Giant trees, often exceeding 150 feet in height, had to be removed occasionally from the midst of a cluster of elaborately sculptured monuments, where a single blow from a falling branch might have shattered the high relief and done irreparable damage.

In such delicate cases the trees first had to be cabled, and then, while they were being cut, gangs of native laborers pulled them away from the endangered monuments.

All this preliminary work consumed much time, and it was not until February of last year that the actual excavation of the site was commenced.

The place selected for the first season's digging was the south side of the temple court, at the points marked A and B on the map, on page 349; and at A a trestle

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* "Incidents of Travel in Central America, Chiapas, and Yucatan." John L. Stephens. Harper & Brothers, 1840.

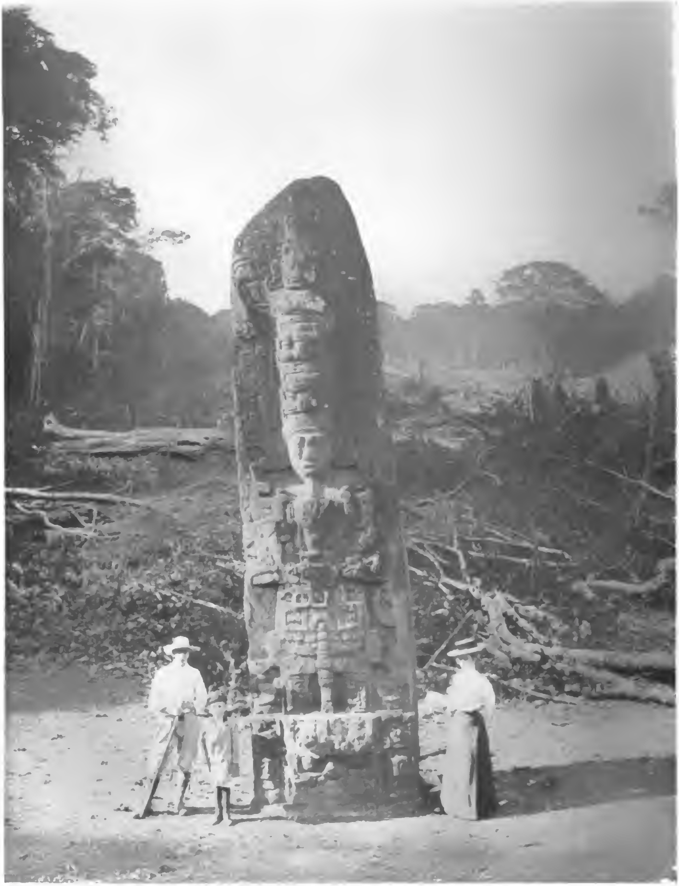


Photo by George N. Bucklin, Jr.

THIS IS ONE OF THE BEST-PRESERVED MONUMENTS AT QUIRIGUA AND IS KNOWN AS STELA D

The relief is very slightly weathered and looks as though it had just left the sculptor's chisel. The Egyptian type of face, with its characteristic little beard, shows very distinctly in this monument. Compare, also, the monuments shown on pages 333 and 334.

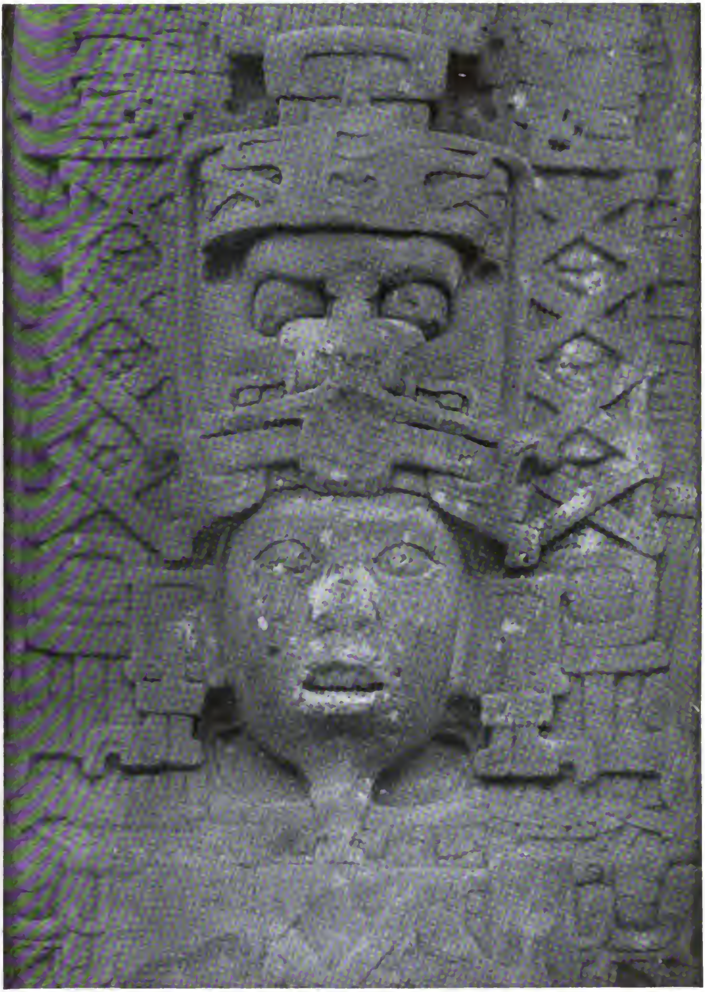


Photo from Sylvanus G. Morley

DETAIL SHOWING A HEAD AND HEAD-DRESS ON ONE OF THE LARGE MONUMENTS

The "cross-bone" decoration on each side of the head-dress is a common motive in Maya art

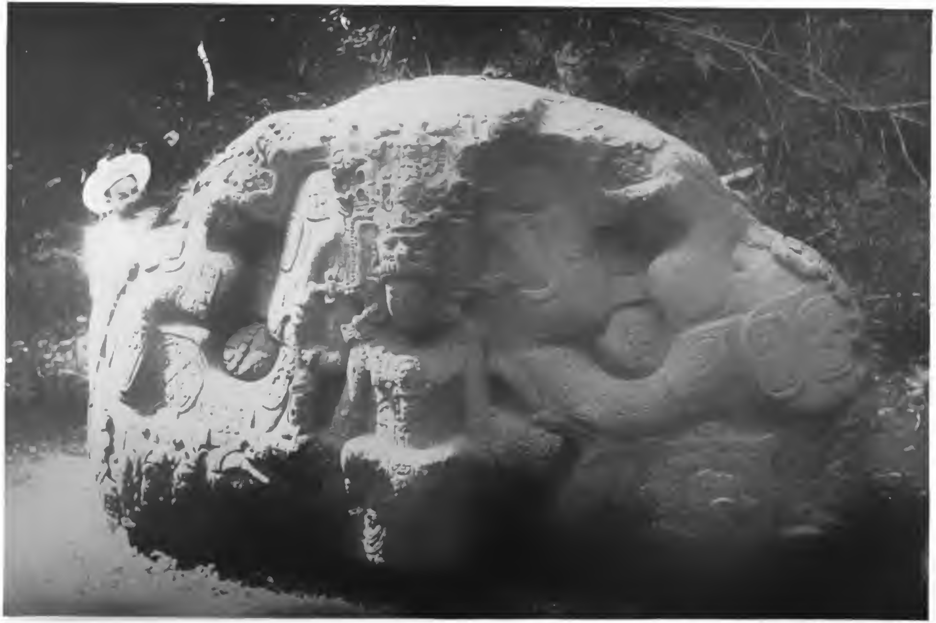
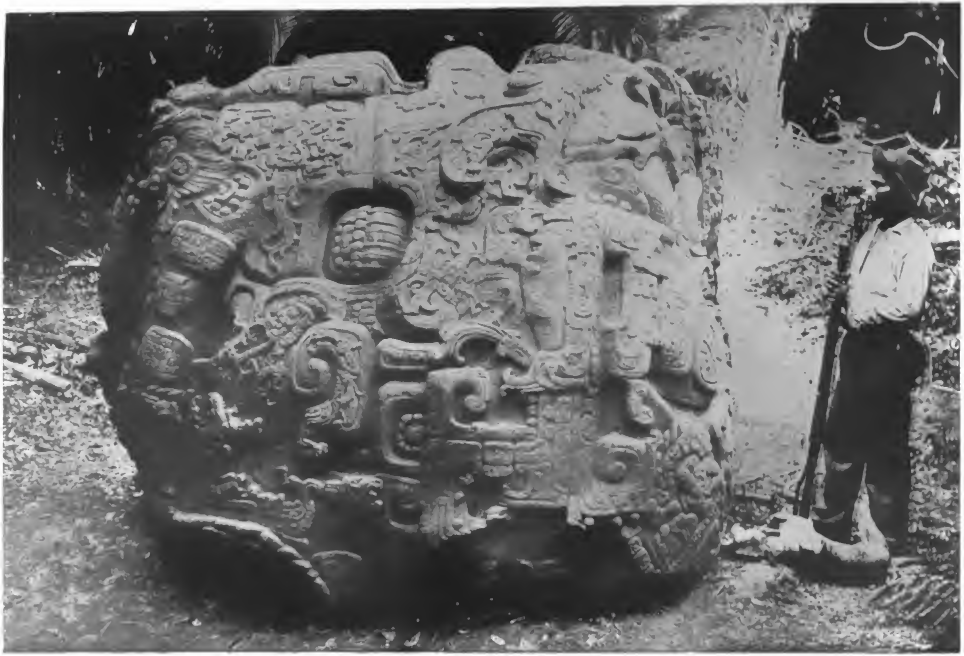


Photo from Sylvanus G. Morley

A SINGLE CARVED STONE REPRESENTING SOME CREATURE, PROBABLY A TORTOISE, AND KNOWN AS ZOOMORPH P

This monument weighs over 50 tons and is said to be the finest piece of aboriginal sculpture in the Western Hemisphere. Every available inch of its surface is elaborately carved, the relief being over a foot in depth in some places



SIDE VIEW OF "THE GREAT TURTLE," OR MONUMENT CALLED ZOOMORPH Z

If this picture be turned upside down, a fine head in profile will be seen just to the left of the center

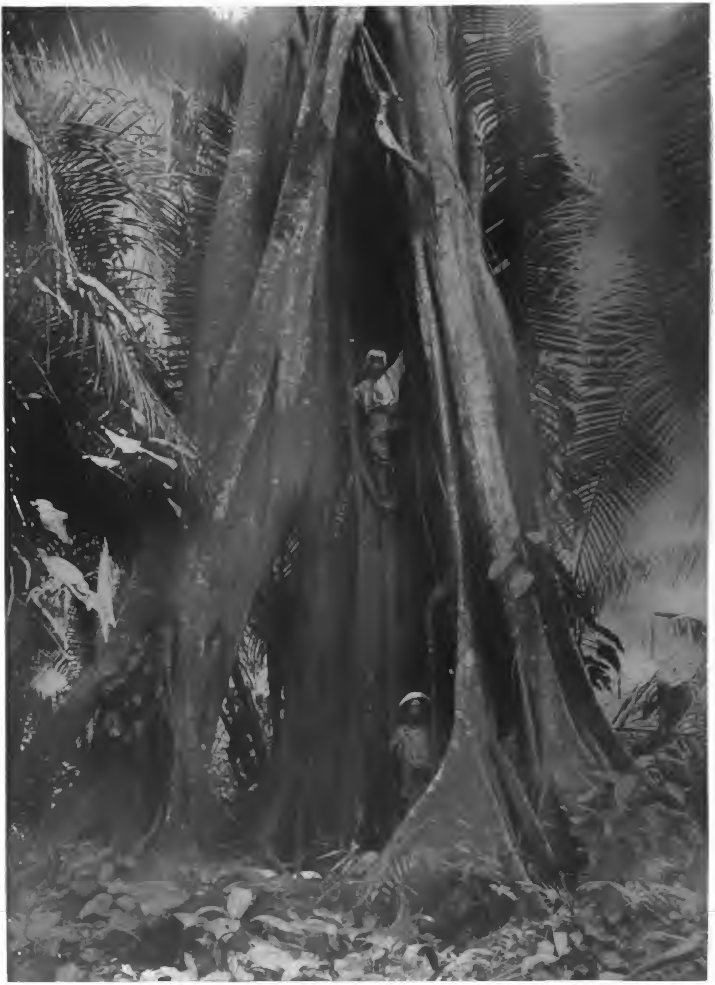


Photo from Sylvanus G. Morley

A MATAPALO TREE

This tree when young grows around some other tree, clinging to it for support. As it grows it gradually surrounds the tree supporting it, and finally ends by choking it to death; hence the name matapalo, or "kill-tree." It is no uncommon sight in the vicinity of Quirigua to see two entirely different foliages emerging from the same trunk. The matapalo illustrated here has succeeded in entirely surrounding the tree which originally gave it a helping hand upward.

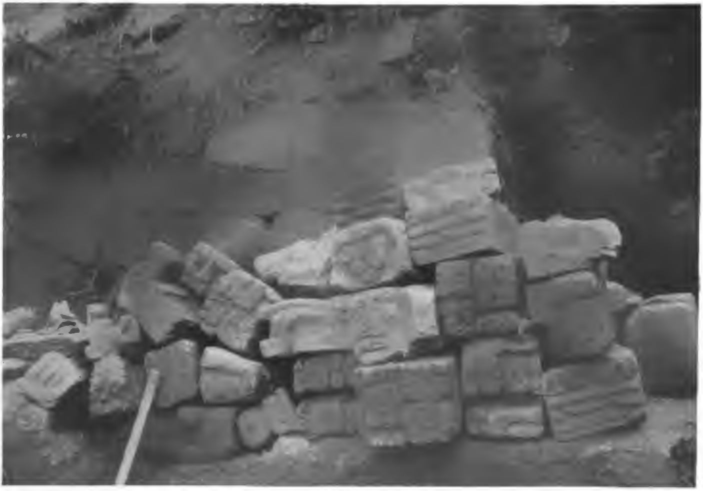


Photo from Sylvanus G. Morley

SCULPTURED FRAGMENTS OF STONE FOUND AROUND THE BASE OF TEMPLE A: NOTE THE CURIOUS VARIETY OF BIZARRE DESIGNS

and tramway were built for carrying off the excavated material (see page 339).

Surmounting the broad and spacious terrace which forms the southern side of the temple court was a large mound. A (see page 348), which, from its size and location, seemed to be the remains of a very important construction.

Fragments of sculptured stone, human and grotesque heads, hands and feet, feather-work and geometric forms, and parts of a hieroglyphic cornice strewed the ground on every side (see page 352), and the first trenches brought to light much additional material of the same character.

AN IMPOSING TEMPLE FOUND

As the work of excavation proceeded there gradually developed from this mound of earth and fallen stone the ground plan of what had originally been an imposing temple. This temple (see the ground plan on page 355) was found to be 105 feet long and 29 feet wide.

It is composed of seven chambers, symmetrically arranged, the three larger ones of which, those opening to the outside, are 14 feet long and about half as wide.

The four interior chambers, alternating with the preceding, are somewhat smaller, being only 9 feet long by 5 feet wide. The floors of the smaller chambers are in every case a foot and a half higher than the flooring of the large chamber from which they are entered; and, similarly, the floors of the larger chambers are again 2 feet higher than the floors of the spacious doorways giving into them. In the latter case the rises of the steps are sculptured with hieroglyphics, drawings of which are shown on page 356. Successive stages in the excavation of the middle chamber of Temple A are shown on pages 350 and 351.

This chamber originally had three heads tenoned into its back wall at a height of 5½ feet above the floor (see bottom row on page 354).

This unusual feature of decoration doubtless indicates a chamber of corresponding importance, which its central

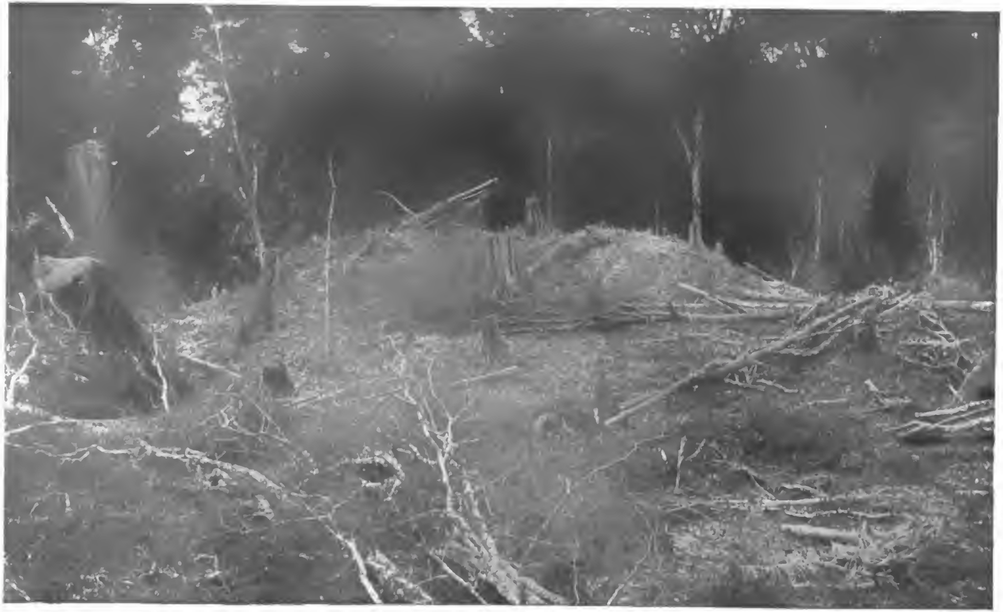
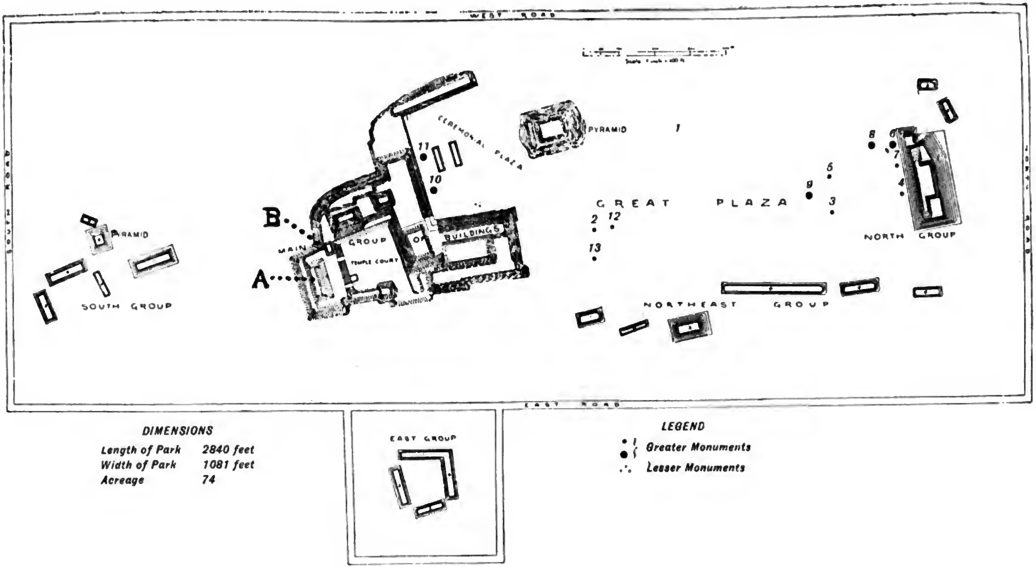


Photo from Sylvanus G. Morley

VIEW OF THE TEMPLE COURT, LOOKING SOUTH, BEFORE EXCAVATION

The mound in the background and the low mound just to the right of it are Temple A and Structure B respectively, before excavation. The view of this same side of the temple court after excavation is shown on page 353



MAP OF THE RUINS OF QUIRIGUA, GUATEMALA

The structures excavated last winter are marked A and B on this map

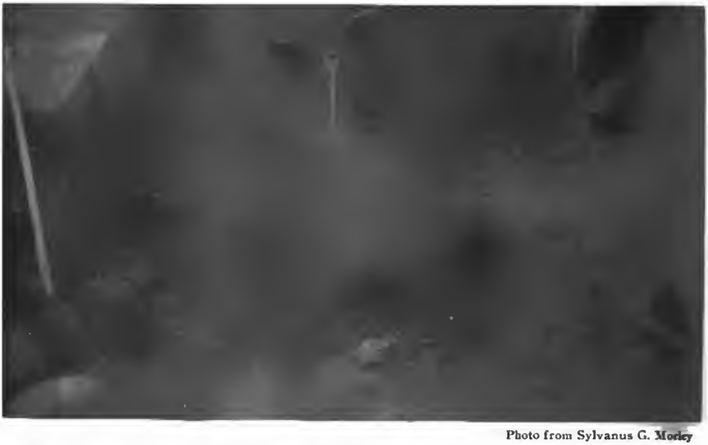


Photo from Sylvanus G. Morley

EXCAVATING THE CHIEF SANCTUARY OF TEMPLE A: (1) CLEARING THE DOORWAY

Photo from Sylvanus G. Morley

EXCAVATING THE CHIEF SANCTUARY OF TEMPLE A: (2) THE SANCTUARY PARTIALLY CLEARED

The back wall of the sanctuary has been partially uncovered and the threshold cleaned out, exposing the hieroglyphic step (see page 356). The three heads in the bottom row of the picture on page 354 were found in the layer of dirt on the floor of this room.

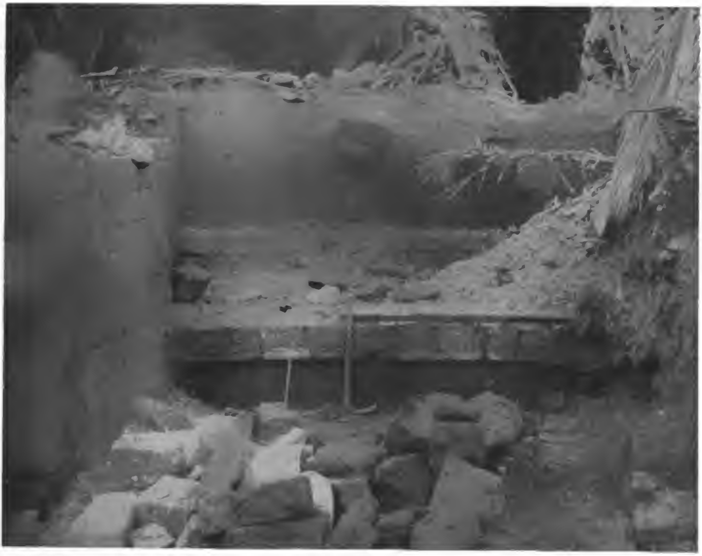


Photo from Sylvanus G. Morley

EXCAVATING THE CHIEF SANCTUARY OF TEMPLE A: (3) THE SANCTUARY AFTER FINAL REPAIR

Note that the wall to the left has been relaid in cement, and the third hieroglyphic, part of which is missing in plate 2, on page 350, has been repaired, the missing part having been found in the debris on the floor of the doorway.

position in the building further corroborates. Indeed, it is more than likely that this chamber of the tenoned heads was not only the chief sanctuary of this particular temple, but of the whole city as well.

A SHRINE FOR HUMAN SACRIFICE?

It requires but little effort of the imagination to picture once again the rich and varied scenes which had this temple for their background. White-robed priests, with jaguar skins hanging from their shoulders, ascend the stairway to the sanctuary. Garlanded victims in the shadow of death tremble at the altar.

Gorgeously plumed chieftains pace the broad terraces or press around the covered dais of the city's ruler, while below, thronging the stone seats along the sides of the court, the multitude, in ignorance and awe as always, awaits the sacrifice. All the pomp and pageantry of the bygone days again fill the court under the magic spell of the romantic surroundings.

Curiously enough, the excavation of this sanctuary failed to bring to light a single specimen, not even a potsherd, although the interior chamber adjoining it on the right yielded a generous return.

Among the specimens recovered from this latter room were two very fine flint spear-heads, each over 6 inches in length, and the fragments of a dozen or more pieces of pottery, which show a variety of pleasing shapes and designs. In general, the Quirigua ware is red, or red and yellow, and of a basin-like shape. Many pieces have three legs, the legs being made of balls or inverted cones of clay.

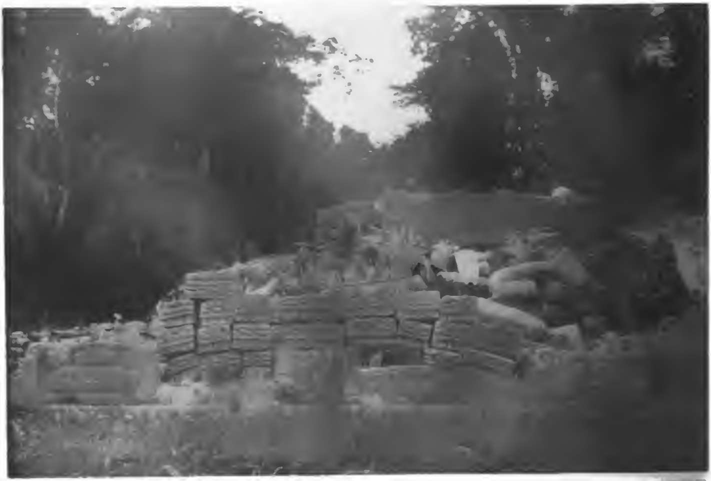


Photo from Sylvanus G. Morley

FRAGMENTS OF THE MEDIAL AND UPPER CORNICES OF TEMPLE A

In the foreground appear several blocks from the hieroglyphic cornice, which divided the facade into two horizontal bands. Behind are blocks from the upper cornice, showing the leaf or feather pattern.

Decoration was largely confined to the exteriors, and was effected by fluting, painting, and incising. It has been suggested that the first of these was derived originally from the calabash, which abounds in the vicinity. The yield of specimens from the other chambers of Temple A was rather meager, all combined being less than the cache just described.

THE TEMPLE CONFORMS TO MAYA TYPE

The façade of Temple A, like that of all Maya structures, was divided into two parts by a cornice which passed around all four sides of the building half way between the top and bottom.

In Temple A this cornice was composed of a band of hieroglyphics which began at the northeastern corner and extended clear around the building. Below this cornice the façade was plain, being without sculptural decoration of any kind.

This severe treatment of the lower panel offered a striking and effective contrast to the upper panel, which was composed of an elaborate mosaic of sculptured stones finished at the top with another cornice showing a leaf motive.

Unfortunately the upper part of the building has suffered most, having fallen at every point, carrying with it all of this sculptured mosaic, not a single stone of which now remains in its original position. This appears very clearly in the picture on page 357, which shows the front or north side of Temple A.

The walls up to the hieroglyphic cornice are perfectly plain. At the left, where the inscription begins and where the sequence of the first 15 or 16 hieroglyphics is known, the cornice has now been restored to the position it originally occupied.

SOME HIEROGLYPHICS DECIPHERED

The hieroglyphic inscription presented on the exterior cornice and on the rises of the steps in the three exterior door-

Photo by George N. Bucklin, Jr.

VIEW OF THE SOUTH SIDE OF THE TEMPLE COURT AFTER EXCAVATION: CONTRAST WITH THE VIEW SHOWN ON PAGE 348

ways of this temple is of unusual interest. The text on the cornice records the date 9.19.0.0.0: 9 Ahau, 19 Mol of Maya chronology, which corresponds approximately to the date 540 A. D.*

This date doubtless indicates the time at which Temple A was erected or at least dedicated. It marks the close of Katun 19 of cycle 9 of the Maya era† and is the latest of all dates yet discovered at Quirigua.

The first two hieroglyphics in the eastern doorway (*a* and *b*, on page 356) record the date 9 Ahau 18 Mol, which is exactly 40 days in advance of the date presented on the outside. The third hieroglyphic in the middle doorway (*c*, on page 356) expresses this distance of 40 days, and the fifth and sixth hieroglyphics, *e* and *f*, the date 9 Ahau 18 Mol, recorded also on the cornice outside.

Finally, the seventh and eighth hieroglyphics in the western doorway, *g* and *h* (page 356), declare that this day, 9 Ahau 18 Mol, was at the end of Katun 19 of cycle 9, thus repeating the information given on the exterior of the building.

WHAT DO THE HIEROGLYPHICS HIDE?

It will be seen from the foregoing that the only Maya hieroglyphics which have been deciphered up to the present time are those which deal with some phase of the calendar, such as day, month, or period, signs, and the like.

Indeed, all told, the meanings of not more than 50 different characters have been worked out, leaving in the neighbor-

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*Authorities differ as to the exact correlation of Maya and Christian chronology. The correlation used here is that proposed by the writer.

† The Maya Katun contained 7,200 days, or approximately 19¾ years. There were 20 katuns in a cycle, which was very nearly 400 years long. Cycle 9 of Maya chronology was the first historic period of the Maya civilization.

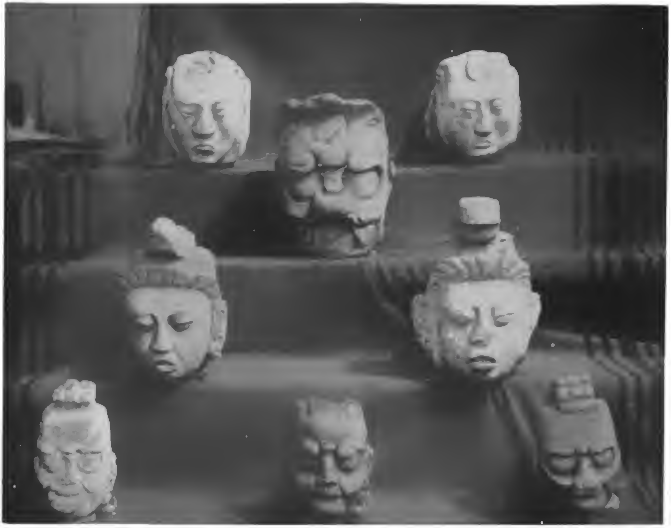


Photo from Sylvanus G. Morley

SCULPTURED STONE HEADS FOUND DURING THE EXCAVATION OF TEMPLE A

These heads, with the exception of the three in the bottom row, were found in front of the temple. Originally they had been fastened to the facade by rough stone tenons projecting from their backs. The large grotesque head in the second row was over the middle doorway, and the two heads in the third row were over the eastern and western doorways respectively. The three smaller heads in the bottom row were fastened to the back wall of the sanctuary, 5½ feet above the floor-level.

hood of 150 which are still indeterminate. These undeciphered hieroglyphics probably treat of the events which occurred on the corresponding dates: or, in other words, they probably deal with the subject-matter of Maya history.

The frame-work of Maya history—that is, its chronology—no longer presents serious difficulties to the student; but the more human side of this great aboriginal civilization, the records of its wars and conquests, its religious and social movements, its rise and fall, still remain a sealed book.

The building material used in Temple A is sandstone, which was quarried from the foot-hills two miles west of the city and probably transported thither on rafts during the rainy season, when the greater part of the valley is submerged by the overflow of the Motagua River.

In this way the building material could be floated right up to the base of the temple substructure. The blocks were finished—that is, either sculptured or faced—as occasion required, after they had been laid in the wall.

This accounts for the remarkable accuracy with which the lines of a design are carried from one block to another without a perceptible break in the composition. This is particularly true of the hieroglyphic cornice, which could have been sculptured only after the blocks were laid in the wall, so perfect is the fit of the lines in the details of the characters.

In addition to the temple just described, one other building (Structure B) was excavated at Quirigua this year (see B, on p. 349). The relation of these two structures appears very clearly in the view of the temple court, shown in the photograph on page 353. This structure B can hardly be classified as a temple, but more readily falls into the dwelling or palace type of Maya structures.

It is built on the level of the temple court and does not rise from a substructure, like the other buildings surrounding this inclosure, which fact somewhat detracts from its dignity and impressiveness. Its ground plan is irregular.

There are no large open chambers rendered further conspicuous by unusual features of decoration, as in Temple A. Instead, the rooms are small and dark, the entrance, shown on page 358, being the only exterior doorway in the entire building.

All of the doorways are provided with pairs of stone hooks for hanging curtains. These are

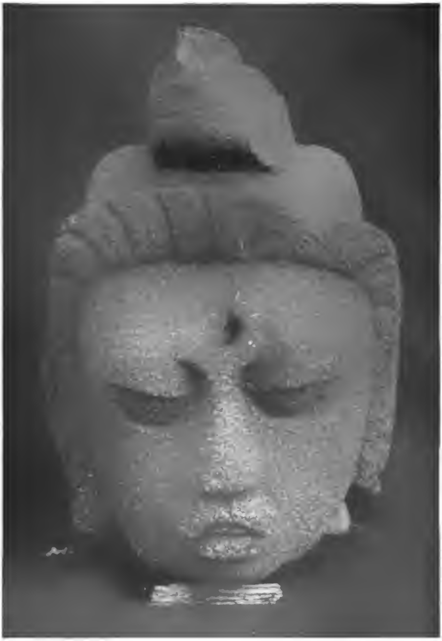
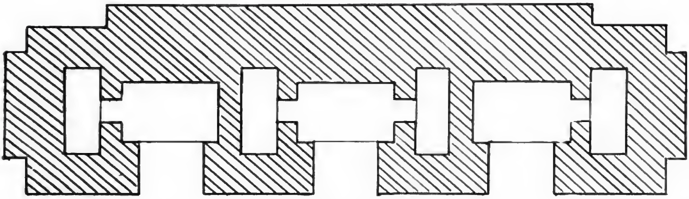


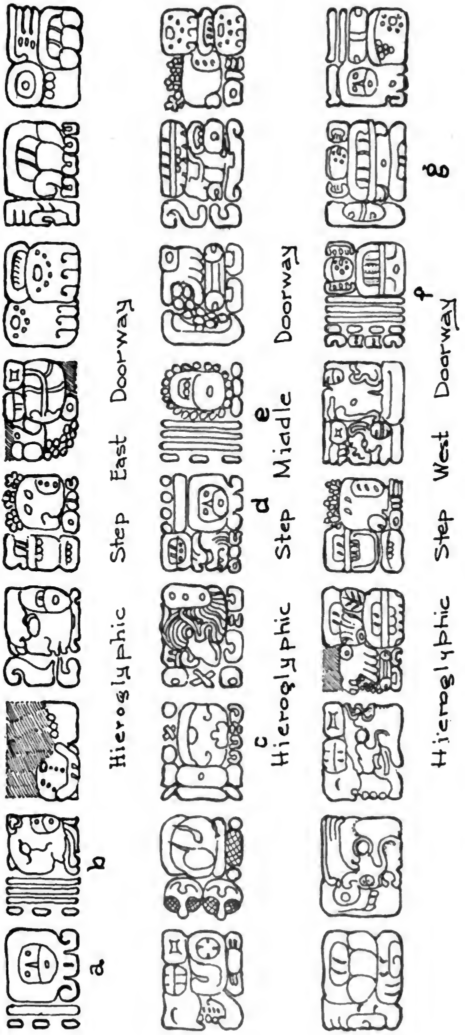
Photo from Sylvanus G. Morley

ONE OF THE STONE HEADS WHICH FORMERLY ORNAMENTED THE FACADE OF TEMPLE A



GROUND PLAN OF TEMPLE A

Note the proportion of wall space to room space in this building. The walls, which are of solid masonry, occupy nearly three times as much space as the rooms


a
b
Hieroglyphic Step East Doorway
c
Hieroglyphic Step Middle Doorway
d
e
Hieroglyphic Step West Doorway
f
g

HIEROGLYPHICS ON THE STEPS OF THE DOORWAYS LEADING INTO TEMPLE A

The hieroglyphics marked *d*, *e*, *f*, and *g* record the date 9 Ahau 18 Mol at the close of Katun 19 of cycle 9 of Maya chronology. This date corresponds approximately to the year 540 of the Christian era, and is repeated on the hieroglyphic cornice outside

Photo by George N. Bucklin, Jr.

NORTH FAÇADE OF TEMPLE A

This view shows the tremendous amount of repair work which necessarily accompanied the excavation of Temple A. When the walls were uncovered they were found to be in an extremely ruinous condition. Most of the building blocks had to be relaid in cement, and all of the walls had to be finished off with a waterproof cap to shed the large annual rainfall.

set in niches in the walls, two hooks on each side of a doorway—one at the floor level and the other 4 feet above. By means of these the door-hangings could be secured in four places and prevented from flapping in the wind.

The exterior of Structure B was decorated with the curious sculptural mosaic shown on page 359. This design occurs at each of the four corners and in the middle of the back and side walls. It is a variation of the grotesque head motive found throughout the Maya area.

A PREHISTORIC ROOSEVELT PORTRAIT

In this particular example the incisor teeth are as prominent as Colonel Roosevelt's, and the first tourists who saw the head immediately called it the original Roosevelt grin. Under this name its fame rapidly spread, until it became the chief point of tourist interest in the ancient city.

The yield of specimens from the smaller structure exceeded that from Temple A in both quality and quantity. Indeed, the finest specimen recovered during the entire course of the excavations—the effigy vase shown on p. 359—came from this apparently insignificant building. When discovered, this vase was broken into a score or more of small pieces, and it was not until after these had been put together that its true character was revealed. It is 7 inches in height and 3 inches in width at the top, flaring slightly at the bottom.

The body of the vase is a rich cream or buff in color, decoration being confined to the fluting already mentioned

The grotesque head which ornaments its front is truly remarkable as an example of free-hand modeling, the features being rendered with a verisimilitude rarely encountered in any aboriginal art

The eyes, ear-rings, fillet, and mouth are painted a dull bluish-white, the beard and fillet decorations being done in a rich

Photo by George N. Bucklin, Jr.

VIEW OF STRUCTURE B AFTER EXCAVATION

"In the deep twilight of a tropical jungle the crumbling remains of this once proud city lie forgotten, its builders unknown, and its very name lost in oblivion—a melancholy commentary on its vanished glory" (see text, page 360).

shade of red. When discovered, this vase was in fragments on the floor of a back room, in a dark and inconspicuous corner.

WHY WAS QUIRIGUA ABANDONED?

In finding such an unusual specimen one is prompted to ask, What dire circumstances could have necessitated its having been left behind? Was it abandoned in the extremity of sudden flight or overlooked in the confusion of an equally hurried sack? Or, again, could some general death or universal pestilence have laid low all the hands which might have borne it off?

The number of conjectures possible is as endless as such guessing is idle. Such questions by their very nature are destined to remain unanswered until the end of time.

In its dark corner, shattered and forgotten, this gem of Maya ceramic art slept undisturbed throughout the centuries, only to be awakened in another day and age by the archeologist's shovel.

Decidedly the most unique article recovered during the course of the work was a series of small worked hematites, found near the effigy vase above described. For the most part these were hexagonal in shape, about 1/16 of an inch in thickness and not over an inch in width between any two points. One side was very highly polished in each case, the other being ground smooth. The edges were beautifully cut, and in some cases finished off round, as though such pieces had formed the border of some mosaic. The use of these curious little stones is unknown.

THE AGE OF THE BUILDINGS

One important point which the excavation of Temple A and Structure B settled beyond dispute was the relative ages of the two buildings. After the southern side of the temple court had been par-

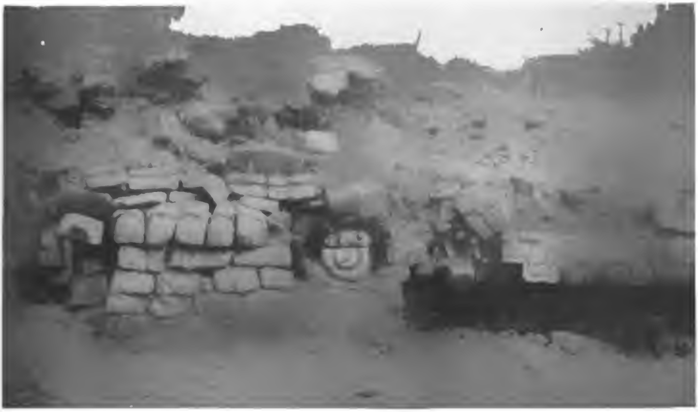


Photo from Sylvanus G. Morley

REMAINS OF A GROTESQUE HEAD ON THE SOUTH FACADE OF STRUCTURE B

The resemblance of the teeth to Colonel Roosevelt's incisors earned for this head the title "the original of the Roosevelt smile" (see page 357)

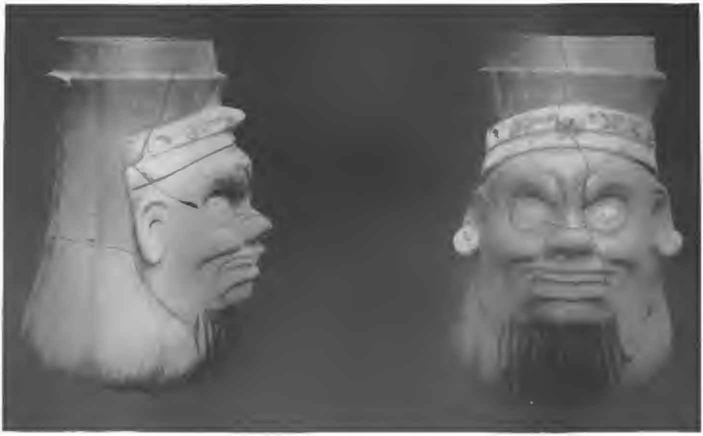


Photo from Sylvanus G. Morley

EFFIGY VASE FROM STRUCTURE B

This vase was found in a dark back room. It had been broken into about 22 or 23 pieces, all of which were recovered, with the exception of two very small fragments not exceeding a quarter of an inch in any dimension. It is unquestionably one of the finest examples of the Maya ceramic art that has ever been discovered (see page 357).

Photo from Wells W. Cooke

WILD CANADA GEESE IN A WHEAT FIELD NEAR THE UNITED STATES BIRD RESERVATION AT STUMP LAKE, NORTH DAKOTA

The bird reservations have been established with a view to affording the birds an undisturbed breeding ground. They vary in size from Hog Island, Wisconsin, which contains only two acres, to the Hawaiian Islands reservation, which extends over more than five degrees of longitude and includes the breeding grounds of more than a million sea birds. Those in North Dakota are in the center of the best duck breeding grounds still left in the United States (see page 378) tially excavated, it became apparent that the small building in the southwest corner—*i. e.,* Structure B—belonged to an earlier epoch than the imposing temple which towered above it. Indeed, Structure B is almost entirely surrounded by the platform of the larger building, which indicates that it was already standing when the foundations of Temple A were laid. This appears very clearly in the illustrations on pages 357 and 358, where Temple A is seen to be on top of the terrace built around Structure B. Except that it was erected at some time prior to Katun 19 (the date inscribed on Temple A), no definite conclusion as to the age of Structure B can be reached.

However, since the very earliest date at Quirigua only precedes Katun 19 by 87 years, it is probable that Structure B was built some time during the century preceding Katun 19, or during the period 440-540 A. D.

The excavation and repair of the two buildings above described constituted the work of the present year at Quirigua. When these ancient structures were finally uncovered, it was found necessary to make extensive repairs in order to preserve them from speedy deterioration and decay.

The building stones had to be relaid in concrete and the walls plumbed and finished off with a waterproof cap of cement to shed the enormous annual rainfall. These permanent improvements, however, necessarily consumed much time, and scarcely had been brought to a close before the rainy season set in, putting a stop to all work, excavation as well as repair.

THE REAL WORK YET TO BE DONE

So far as the possibilities of the site are concerned, the ground at Quirigua may be regarded as having been little more than scratched. The temple court alone has four other buildings surrounding it, to say nothing of the remaining courts and plazas of the city.

It is the purpose of the School of American Archeology to continue excavations here until an exhaustive study of the site has been made; for only through systematic investigations extending over a number of years can these great centers of the Maya civilization be made to tell their interesting story and contribute their quota to the record of man's progress and development.

Meanwhile, in the deep twilight of a tropical jungle the crumbling remains of this once proud city lie forgotten, its builders unknown, and its very name lost in oblivion—a melancholy commentary on its vanished glory.

SAVING THE DUCKS AND GEESE

BY WELLS W. COOKE

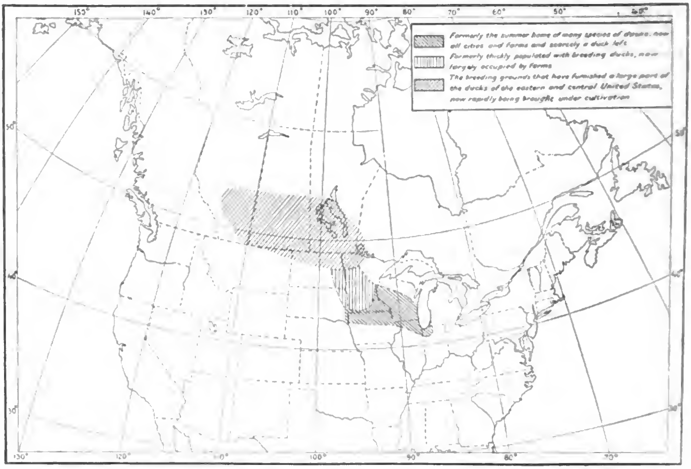
BIOLOGICAL SURVEY, U. S. DEPARTMENT OF AGRICULTURE

Author of "Birds that Fly from Pole to Pole," in the National Geographic Magazine

WHEN the first settlers came to the United States they found the country teeming with waterfowl; the district along the Atlantic coast seemed to have an inexhaustible supply of ducks and geese. But in later years, when emigrants pushed westward and crossed the Mississippi, they discovered that the flocks of the coast were as nothing to the countless throngs that passed each spring and fall over the Western prairies.

The younger generation living today in Iowa and Wisconsin can have no idea of the abundance of ducks and geese found there 50 years ago, at which date their original numbers had been scarcely diminished.

Ducks and geese are by nature prairie, marsh, and swamp-breeding birds. A


Formerly the summer home of many species of ducks, now all cities and farms and scarcely a duck left
Formerly thickly populated with breeding ducks, now largely occupied by farms
The breeding grounds that have furnished a large part of the ducks of the eastern and central United States, now rapidly being brought under cultivation
150°
140°
130°
120°
110°
100°
90°
80°
70°
60°
50°
40°
50°
40°
30°

MAP SHOWING THE BEST BREEDING GROUNDS OF WILD DUCKS AND GEESE

"All the lightest shaded area within the United States has now been brought so thoroughly under cultivation that it can never amount to much as a nursery for young ducks. The next heavier shading includes much of Minnesota and North Dakota, where there are still a great many lakes and marshes too large ever to be drained. . . . The most heavily shaded part in the northern United States and southern Canada represents what is left of the 'ducks' paradise'" (see text, page 363).

few species, such as the wood-duck, merganser, and golden-eye, nest in hollow trees; but those which are the most important from the standpoint either of food or sport—the Canada goose and the mallard, pintail, teal, redhead, and canvasback—breed in the open country.

DUCKS PREFER THE WEST FOR NESTING

The whole region east of Indiana and north of the Potomac River, including also all of Canada east of Lake Huron and Hudson Bay, has never had more than a few small tracts suitable for breeding grounds. Only one species—the black duck, or black mallard—nested there commonly, and that in numbers insignificant as compared with those of its nearest relative, the common mallard, in the Mississippi Valley.

In fact, the settlement of this eastern part of the country has decreased the acreage of duck-breeding grounds so little that if the black mallard was allowed proper protection, it would still nest in goodly numbers throughout this entire area.

No other duck seems to have cared to nest in any numbers east of Hudson Bay, and the enormous flocks of ducks reported by the early settlers, in the fall migration, were not eastern-bred birds, but were travelers from the interior of the North American continent, where tracts of country furnishing exactly the conditions desired by ducks and geese were to be measured by square miles instead of acres.

The so-called "prairie region" of the United States then extended into Illinois and northwestern Indiana, and so much of it as was occupied by lakes and marshes—northern Indiana, a wide strip of northern Illinois, another strip of northern Iowa, and thence northward to the Arctic Ocean — was crowded with breeding ducks and geese. The map (see page 362) shows the approximate outlines of this area.

It is noticeable at once that much of the lower half of this vast region, formerly held in undisturbed possession by wildfowl, is now an almost continuous farm and garden, and the millions of waterfowl have been replaced by several millions of human beings.

WHERE THE DUCKS' PARADISE IS FOUND

The prairie districts of central Canada, comprising large portions of Manitoba, Saskatchewan, Alberta, and Mackenzie, have been and still are the "ducks' paradise." Almost equally attractive to them are the northern part of North Dakota and much of northwestern Minnesota, the whole forming a tract 200 miles wide and 400 miles long, abounding in lakes, ponds, sloughs, and marshes, which furnish ideal nesting conditions and a plentiful supply of food; and 50 years ago every available nook was preëmpted by waterfowl.

But the "paradise," too, has been disturbed. The Northern Pacific and other railroads cut across its southern border in Minnesota and North Dakota, a north and south line was run to Winnipeg, and other shorter branches were built.

A still more severe blow was dealt the waterfowl when the Canadian Pacific Railroad crossed, between Winnipeg and the Rocky Mountains, the finest duck-breeding grounds on the continent. During the decade just ended their last stronghold has been invaded by the new Grand Trunk Pacific Railroad, and soon the great colonies of northern Alberta and northern Saskatchewan will be things of the past.

It is evident, therefore, that in a few years neither the United States nor southern Canada will have any large breeding places of those species of ducks which are most highly valued for sport and for the table.

The map on page 362 shows the existing status of the breeding grounds which have been enumerated. All the lightest shaded area within the United States has now been brought so thoroughly under cultivation that it can never amount to much as a nursery for young ducks.

The next heavier shading includes much of Minnesota and North Dakota, where there are still a great many lakes and marshes too large ever to be drained. Though the number of ducks throughout this area has been greatly diminished, yet in the aggregate a good many broods are reared each year.

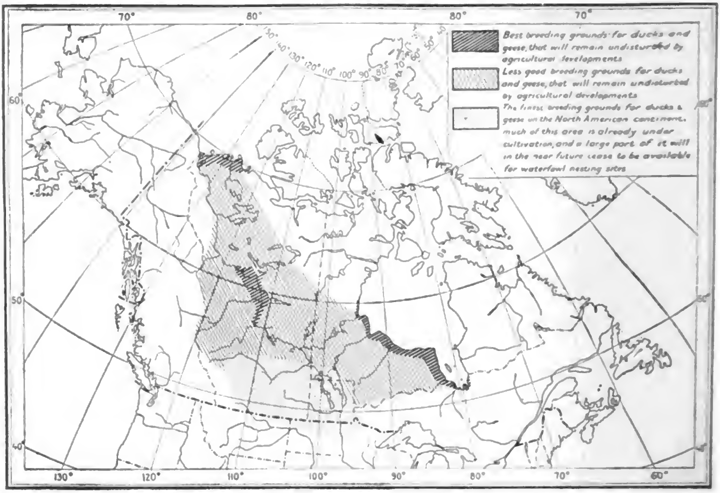
The most heavily shaded part in the northern United States and southern Canada represents what is left of the "ducks' paradise," and nesting ducks are still present in large numbers over the whole area.

THE FUTURE IS BY NO MEANS HOPELESS

Owing to two facts, the future of the ducks and geese of North America is not so gloomy as some are inclined to think. First, there is a rapidly awakening interest in the preservation of game of all kinds, and, second, there is an overlooked area in North America of considerable size, which is well adapted for the breeding grounds of ducks and geese, and is so far north and has so severe a climate that it never will be used to any great extent for farming. Indeed, the places best adapted to the waterfowl—the great marshes—are too wet and cold even in mid-summer ever to be available for agriculture.

The largest and best of these districts lies in the neighborhood of Athabaska and Great Slave lakes. It includes the whole of the Slave River, the lower hundred miles of the Athabaska River, and the region to the westward for distances varying from 50 to 250 miles.

Here are some 30,000 square miles that with even moderately good protection during the breeding season will produce annually a liberal crop of the most valued kind of ducks. To the northward lies another district, including the delta of the Mackenzie and the Arctic coast east to Franklin Bay, that supports each year a large waterfowl population, including the mallard, green-winged teal, and several species of geese, but is too far north for the gadwall, blue-winged teal, redhead, and canvasback (see map, p. 364).



70°
80°
80°
70°
▨ Best breeding grounds for ducks and geese, that will remain undisturbed by agricultural developments
░ Less good breeding grounds for ducks and geese, that will remain undisturbed by agricultural developments
☐ The finest breeding grounds for ducks & geese on the North American continent. much of this area is already under cultivation, and a large part of it will in the near future cease to be available for waterfowl nesting sites
60°
50°
40°
130°
120°
110°
100°
90°
80°
70°
60°

MAP SHOWING THE ALMOST UNDISTURBED BREEDING GROUNDS OF THE DUCKS AND GEESE IN NORTHERN CANADA

Which will prevent the extermination of these waterfowl if they receive adequate protection in the United States (see text, page 363)

Eastward a third area fringes Hudson and James bays on the west and extends from the south end of James Bay to 100 miles beyond Cape Churchill.

Many ducks have nested from time immemorial throughout this region and have been practically undisturbed by man, and it seems probable that this condition will continue for years to come.

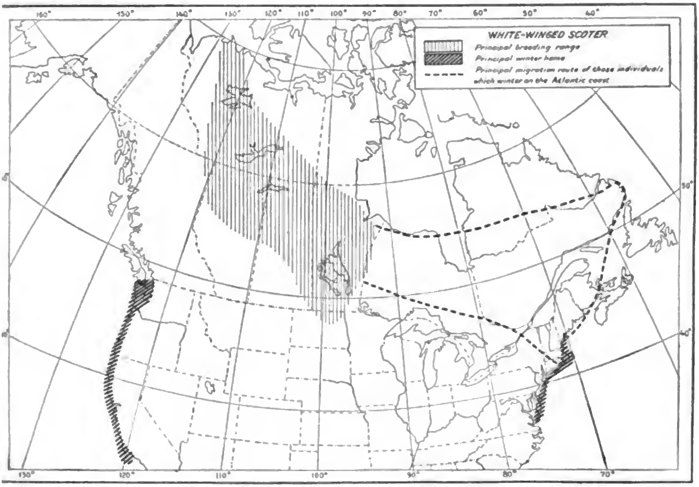
These three districts are the best, but throughout the whole immense intervening area—lightly shaded on the map shown above — are innumerable small lakes and marshes, each well adapted to support a few pairs of ducks and geese. Moreover, by suitable legislation, southern Saskatchewan, nearly the whole of Manitoba, and the contiguous parts of the United States can be made to produce perennially their present large crop of aquatic game birds.

WHY PROTECTION PAYS

Some birds are protected because of their diet, as the wood-peckers and fly-catchers; others for their song—thrushes and mocking-birds; others for esthetic reasons—gulls and terns; while the protection of ducks and geese is purely utilitarian; they furnish a highly prized food, and the sport of hunting them involves an outdoor life and exercise which is worth far more to the individual and the community than the dietary value of the game secured.

Twelve years ago the national government recognized the need of preserving the ducks and geese as part of the national resources and they were included in the "Lacey Act"—the national law for the preservation of game. The enforcement of this law was put in the immediate charge of the Bureau of Biological Survey, and the facts contained in this article were gathered mainly in the course of investigations connected with the carrying out of the provisions of that act.

Under that law wild ducks and geese are the property not of the individual on whose land they happen to nest or alight,



MAP SHOWING BREEDING GROUND, WINTER HOME, AND CURIOUS MIGRATION ROUTES OF THE WHITE-WINGED SCOTER

"Its breeding grounds cover an immense area in Canada. . . . In the fall some of these scoters go west and southwest to winter along the whole Pacific coast of the United States. . . . But most scoters in the fall take an easterly flight, and they are particularly abundant in winter on the Atlantic coast from Cape Cod to southern New Jersey, especially in the neighborhood of Long Island Sound" (see text, page 367).

but of the whole people, as represented by the State, and the modern doctrine of the conservation of natural resources requires that the laws be so framed that the State—*i. e.*, the people—shall receive the largest practicable return for each bird.

Experience of the last few years has shown conclusively that a duck killed for the home consumption of the gunner, or, as it is ordinarily called, "killed for sport," yields a manifold larger return to the State and to the community than one killed by a market gunner as a means of obtaining a livelihood; or, to put it in the baldest way, a market gunner adds nothing to the wealth of the community and obtains his living by an unnecessarily high drain on the State's assets.

WHAT IS THE MOST URGENT NEED?

Hence the most urgent need at this time is to forbid by law, at least for a time, all purchase or sale of domestic game birds. With this as the universal law in Canada and all of the United States—as it is already in 19 of the States—the business of the market gunner is gone; he need no longer be taken into account, and it seems probable that this single restriction will be sufficient to stop to a great extent, if not entirely, the present falling off in our waterfowl census.

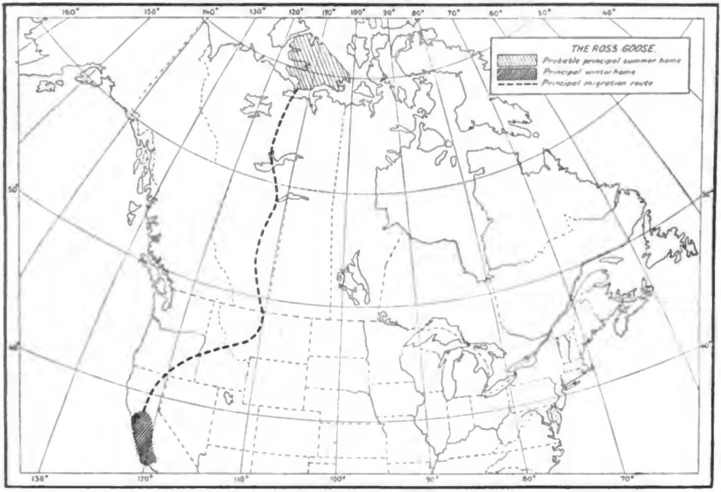
To impress this idea on the general community is the most important single item in the struggle for game protection. It gives a solid cash basis to the appeal for restrictive laws, and when once the public come to see this matter in its true light, the fight for game protection is won.

Some birds protect themselves. For instance, the abundant and well-known white-winged scoter — or white-winged "coot," as it is more commonly known

Photo from Wells W. Cooke

MALLARDS FEEDING ON THE PRESERVE OF E. A. MC ILHENNY: AVERY ISLAND, LOUISIANA

"Here congregate thousands and tens of thousands of mallards, accompanied by teal, widgeon, shovelers, and redheads, with a large number of geese of several species. The best feeding is in a comparatively narrow strip along the coast, and this region fairly swarms with waterfowl" (see text, page 375).



THE BREEDING GROUND AND WINTER HOME OF THE ROSS GOOSE

"From its breeding grounds on the high Arctic Islands it comes south through the Mackenzie Valley; but instead of turning to the southeast, to winter on the Gulf coast with the other geese and ducks which have been its traveling companions, it parts company with them at the national boundary line, goes south into Montana, and then strikes westward, crossing the lofty ranges of the main chain of the Rocky Mountains and winters in California" (see text, page 368).

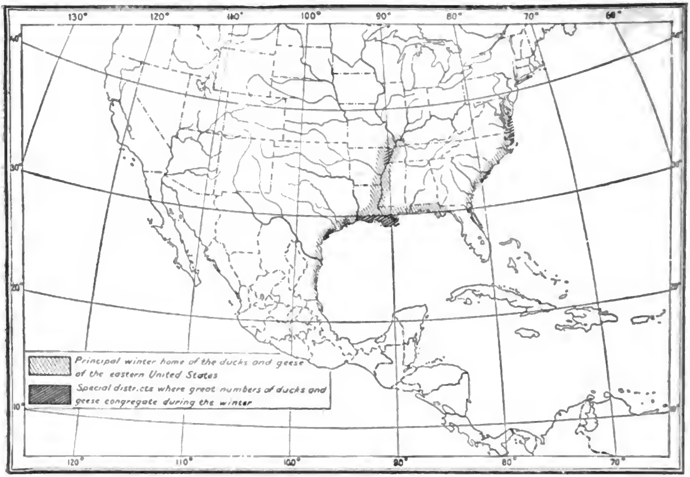
on the New England coast—is probably as common now as it was 50 years ago, in spite of scant protection by law. The reason for its escape from the woeful fate of its relatives is found in the regions chosen for summer and winter sojourn and in its unique migration route or, rather, routes.

Its breeding grounds (see map, page 365) cover an immense area in Canada and are mainly in a district which is still sparsely inhabited and is likely to remain so; at least, it will hardly have population enough to interfere with the nesting of the birds. In the fall some of these scoters go west and southwest to winter along the whole Pacific coast of the United States. Here they have not as yet been much molested, owing to the small market demand and the difficulty of getting within shot range, as they both feed and sleep on the ocean.

But most scoters in the fall take an easterly flight, and they are particularly abundant in winter on the Atlantic coast from Cape Cod to southern New Jersey, especially in the neighborhood of the eastern end of Long Island Sound. Here 100,000 and more have been seen in a single day; but as they, too, remain continually on the ocean, they are less easily killed than are birds which feed closer to land.

CURIOUS MIGRATION ROUTES

Another peculiarity is the migration routes of these Atlantic Ocean wintering birds. Although few, if any, nest in the Labrador Peninsula, yet in August they become abundant as migrants along the east coast of southern Labrador, showing that they must have come 1,500 miles almost due east from their nearest breeding grounds in Canada. In the late fall


130°
120°
110°
100°
90°
80°
70°
60°
40°
30°
20°
10°
Principal winter home of the ducks and geese of the eastern United States
Special districts where great numbers of ducks and geese congregate during the winter
120°
110°
100°
90°
80°
70°

MAP SHOWING THE PRINCIPAL WINTER RESORTS OF THE WILD DUCKS AND GEESE

they repair to the Gulf of St. Lawrence and gradually work south on the advent of winter to the southern New England coast.

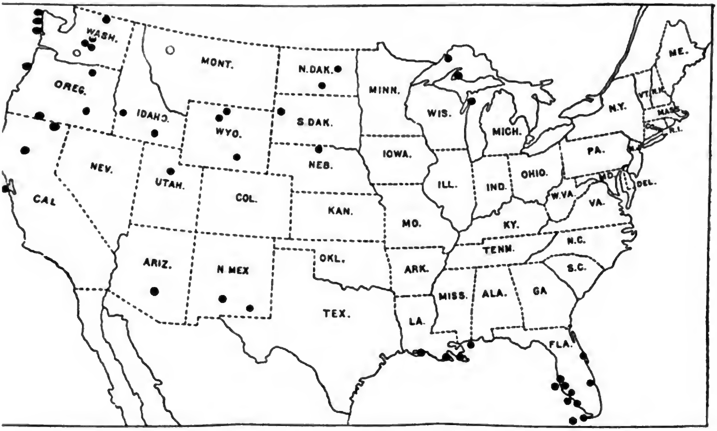
The following spring, instead of retracing the round-about fall migration route, the main flight of coots takes a short cut west in Long Island Sound to the mouth of the Connecticut; up the valleys of the Connecticut and Hudson rivers to the valley of the Ottawa, and thence west and northwest to the breeding grounds. Thus during their fall migration they are passing through a country almost entirely uninhabited, while their spring flight over the thickly populated parts of Connecticut and New York is made for the most part by night. Under these circumstances it is not surprising that the scoter succeeds in holding its own.

Another species that has an equally peculiar migration route is the Ross snow goose. It is one of the very rare geese in North America and is also the smallest, about the size of a mallard duck. From its unknown breeding grounds on the high Arctic Islands it comes south through the Mackenzie Valley; but instead of turning to the southeast to winter on the Gulf coast with the other geese and ducks which have been its traveling companions, it parts company with them at the national boundary line, goes south into Montana, and then strikes westward, crossing the lofty ranges of the main chain of the Rocky Mountains and winters in California (see map, page 367).

WHEN SHOULD THESE BIRDS BE PROTECTED?

The problem of waterfowl protection has four distinct phases corresponding to the four seasons of the year. The summer or the breeding season is acknowledged to be the time when the shooting of ducks and geese is most pernicious. Practically all our States and Canada are agreed that hunting should cease absolutely during the weeks when the birds are nesting.

Only a little less disastrous is hunting during spring migration, when the lucky survivors of the winter's campaign are on their way to the nesting grounds. Just now the struggle for game preservation



MAP SHOWING THE LOCATION OF 46 OUT OF THE 56 NATIONAL BIRD RESERVATIONS

The other 10 are located in Alaska, Hawaii, and Porto Rico (see text, page 375)

in the United States is centering around the proposition to abolish all spring shooting. This has already been done by several of the States which are most enlightened in their treatment of wildfowl preservation; but enormous numbers are still shot in Iowa and especially in the bottoms along the Illinois River.

It is confidently expected that in the near future the good sense of the general community will recognize how short-sighted and wasteful it is to lose a large fall supply of well-fattened fowls for the privilege of obtaining earlier in the year a much smaller quantity in poor condition.

Some advocates of spring shooting claim that hunting can safely be allowed until the ducks begin to pair; but the pairing season with some species is very early in the year; the wood-duck begins nesting in early February, and some of the other species are paired by the middle of the month. Any attempt to make separate laws and dates for the different species would prove unsatisfactory, and the only practicable way is to prohibit all spring shooting.

WHY A SHORT HUNTING SEASON IS MOST PROFITABLE

Admitting that both spring and summer shooting are utterly indefensible, the question is at what time may hunting properly and profitably be allowed. The matter of game protection should be handled from a rational business standpoint, like the handling of any agricultural product. There is some one time in the growth of a crop when its yield will be of the highest market value, and the wise agriculturist waits for that time and then harvests in a few days the output of the whole year. Moreover, he is careful to save enough for seed, so that the crop of the following year may be at least no less bounteous.

Every one will admit that the greatest number of waterfowl of the highest value individually can be obtained yearly if all the shooting is done—*i. e.*, the year's crop is harvested—in the fall, after the young are fully grown and while the birds are on their fall migration trip. If birds are absolutely undisturbed by human agencies from the time they reach their winter home until they have completed the molt

Photo by Herbert K. Job

WILD LESSER SCAUPS BEING FED BY HAND AT PALM BEACH, FLORIDA

"At Palm Beach, Florida, where no hunting is allowed within a mile of the town, ducks have become so tame that they will come for food within a few feet of a person, while outside the mile limit these same birds are so wild that it is difficult to get within gunshot range of them" [illegible] the following fall, they will rear the largest proportion of the largest-sized families and furnish the greatest amount of food and sport.

WINTER SHOOTING IS DISASTROUS

To understand the importance of prohibiting the winter hunting of waterfowl in the United States it is necessary to know something about the districts in which the birds are found at this season and the conditions surrounding them there. Ducks must have open water, and hence winter in the Southern States. They retire southward slowly in the fall, as they are driven away from their feeding places by the advancing ice. Many do not reach their real winter haunts before December and some not until the end of that month. Though the outside boundaries of this winter home include a large area, the birds concentrate themselves on that very small fraction of the area which offers good physical conditions and plenty to eat.

For instance, Arkansas contains 53,000 square miles, but Mississippi County, with less than 900 square miles, is more important as a duck winter resort than all the rest of the State. In other words, during the winter the majority of the ducks of Arkansas are collected on less than 1/60th of the State's area. Obviously, under such conditions, the bagging of a great many at one time and place is a comparatively easy matter; hence the market hunter seeks out these favorite feeding spots and shoots there all winter.

Accomac, Northampton, and Princess Anne counties, in Virginia, with an area of less than 1,000 square miles, send to market more ducks than all the other 32,000 square miles of the State put together. In fact, if the shipment or sale of ducks was prohibited in these three counties, it would have more effect in checking the present deplorable decrease of ducks there than would absolute prohibition of hunting in all the rest of the State.

Evidently, then, if the ducks can be protected during the winter in such favored localities, the progressive reduction of the duck population would change speedily to a progressive increase.

The map (see page 368) shows the general area of the principal winter homes of the ducks and also the special feeding places where they congregate.

WHY THE CANVASBACK LEFT CHESAPEAKE BAY

Among the latter, Chesapeake Bay is not marked, although 60 years ago it was one of the most important wintering places for ducks in the United States, usually spoken of as a winter resort, though really there was a time during most winters when the ducks were forced by the ice farther south for a few days or weeks.

Persistent persecution by gunners from early fall to late spring has almost annihilated the myriads of fowls of the finest varieties that used to blacken the surface of the bay. Here was the preferred winter home of the celebrated canvasback, whence many hundred thousand dollars' worth of the birds have been shipped to the northern markets. Today a canvasback is almost a rarity in Chesapeake Bay, and the few survivors spend the winter farther south, on the North Carolina coast.

Chesapeake Bay was formerly the natural goal of a large proportion of the canvasbacks and redheads which nested in central Canada. They had a peculiar migration route. Nesting in the lake region of Manitoba and Saskatchewan, they found stretching thence southeastward an almost continuous chain of lakes supplying an abundance of food and especially favorable conditions to tempt a journey in that direction. This flight led, naturally, to Chesapeake Bay, which used to provide an almost unlimited quantity of their greatest delicacy—wild celery — and otherwise was admirably adapted for a fall, winter, and spring sojourn, except during an occasional week or two of unusually cold weather.

This southeast and northwest route is still used by most of the thousands of ducks that winter on the entire Atlantic coast from Virginia southward, and the now almost deserted waters of the upper Chesapeake would be repopulated to a large extent if wise restrictive legislation were in force.

The south shore of Long Island, N. Y.,

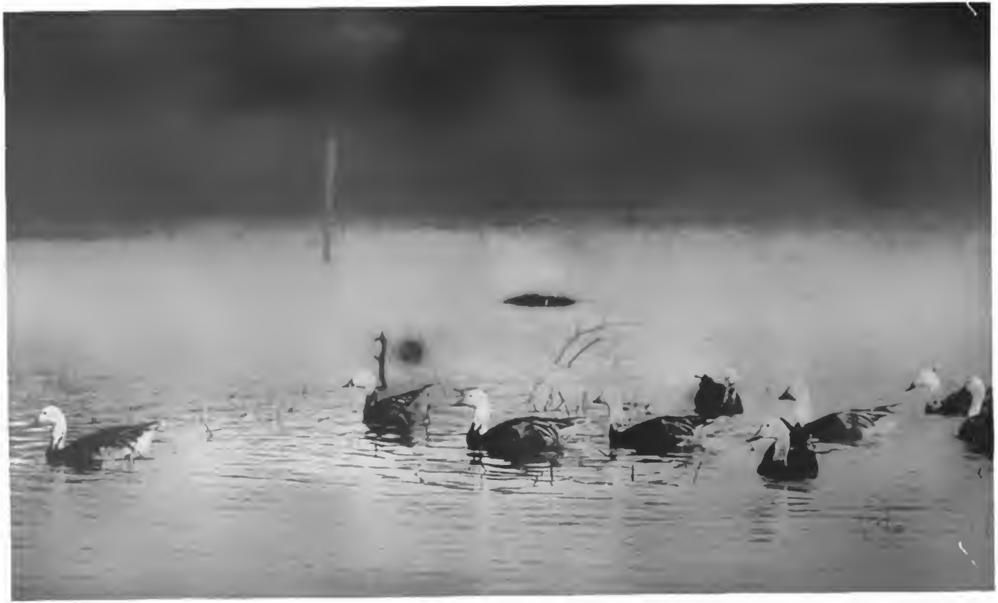
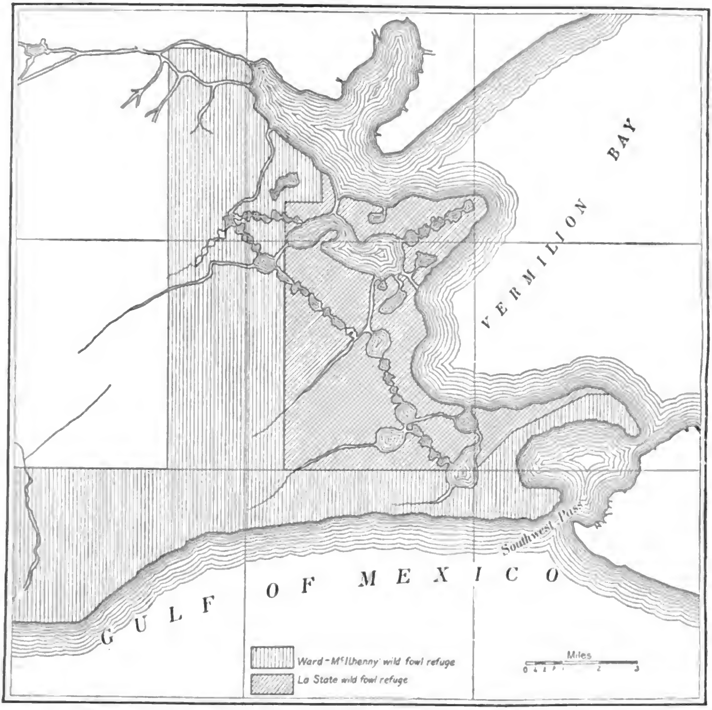


Photo from Wells W. Cooke

WILD BLUE GEESE ON THE PRESERVE OF E. A. MC ILHENNY: AVERY ISLAND, LOUISIANA

This is one of the rare species which the new Ward-McIlhenny Game Refuge will help to preserve from extermination. "Here is the principal winter home of the blue goose, one of the rarest and most interesting of North American geese. Going northward in the spring, their pathway can be traced until they reach Hudson Bay. There they disappear; the nest and eggs have never been found, and no white man has ever reported seeing a blue goose in the summer" (see text, page 377).



THE WARD-MC ILHENNY AND THE LOUISIANA REFUGES FOR GAME BIRDS

"Two gentlemen—C. W. Ward and E. A. McIlhenny—purchased some 50,000 acres and hired game wardens at their own expense to patrol the district and prevent all shooting. Later they deeded 13,000 acres to the State of Louisiana to serve as a perpetual bird refuge" (see text, page 377).

Currituck Sound, N. C., and the neighborhood of Georgetown, S. C., are now the most important ducking grounds on the Atlantic coast. Gunning clubs have obtained possession of most of the best hunting places on these coasts, but the market gunner is still quite notably in evidence.

Many ducks winter on the Texas coast near Galveston and some even venture south to the Mexican coast, at Tampico. Fortunately in these localities the market hunter has ceased to be an important factor of the question, for Texas has prohibited absolutely all shipment of waterfowl out of the State for sale.

The northeastern corner of Arkansas, around Big Lake, is one of the special danger spots from the ducks' standpoint. A constant succession of flocks occupy the region during a protracted fall migration and most of the time throughout the winter. The conditions are favorable for their easy slaughter, and almost un-

Photo from Wells W. Cooke

BLUE-WINGED TEAL ON THE PRESERVE OF E. A. MCILHENNY: AVERY ISLAND, LOUISIANA

"The whole coast from the mouth of the Mississippi to the Texas border abounds with lakes and marshes and offers most alluring winter attractions for ducks" (see text, page 375) believable stories are told of the thousands of mallards sent to market by single gunners.

WHERE THE GREATEST SLAUGHTER TAKES PLACE

There remains for consideration the coast of Louisiana, which at present is the leading factor working for the extermination of those species that have a high market value. The whole coast from the mouth of the Mississippi to the Texas border abounds with lakes and marshes and offers most alluring winter attractions for ducks.

Here congregate thousands and tens of thousands of mallards, accompanied by teal, widgeon, shovelers, and redheads, with a large number of geese of several species. The best feeding is in a comparatively narrow strip along the coast, and this region fairly swarms with waterfowl.

Here are collected on a few hundred square miles the ducks that during the breeding season have been scattered over many hundred thousands of square miles. They begin to arrive early in the fall, remain until late in the spring, and throughout this whole long season they are the easy prey of the market hunter, for the State game law allows duck shooting during the entire winter.

It is extremely difficult to make the inhabitants of southern Louisiana grasp the idea that such conditions are exceptional, or that there is any possibility that their winter sport can endanger the game supply of a continent. Yet a careful census in 1910-1911 of the ducks killed in Louisiana during that one winter totaled so many hundreds of thousands as to be almost unbelievable.

Is it any wonder that spring after spring the hunters in the upper Mississippi Valley report the migrating flocks as becoming smaller and smaller?

So loth are ducks and geese to relinquish their choice feeding places that they return there day after day in spite of incessant shooting, and it is estimated by good authority that at every shooting ground frequented by market hunters, both on the North Carolina coast and in southern Louisiana, at least 50 per cent of all the ducks that winter there are killed before the remnant depart in the spring.

No class of birds can stand such slaughter, especially when there is added to this 50 per cent all those shot during the spring and fall migrations.

BIRD RESERVATIONS WILL SAVE THE WATERFOWL

The immediate end to be sought is the stopping at once of any further inroads on the already badly depleted ranks of the ducks and geese. To effect this, regulations should be made which will shorten the open season and eliminate the market hunter. Later the task will be to restore the old-time abundance of waterfowl, at least as far as is consistent with the development of agriculture.

Fortunately this work can be turned over to the ducks and geese themselves. They have high reproductive powers in natural, undisturbed surroundings, and take kindly to any good offers of safe nurseries for ducklings. Hence has arisen the idea and practice of setting aside certain parts of the national domain as bird refuges or bird reservations.

The first of these—Pelican Island, Florida—was established by the executive order of President Roosevelt, March 14, 1903, and in the nine years to February 21, 1912, 56 such reservations had been segregated (see map, page 369). They are scattered over the possessions of the United States, from Alaska to Porto Rico and from Florida to California and Hawaii. They vary in size from Hog Island, Wisconsin, which contains only two acres—the home of a large colony of gulls—to the Hawaiian Island reservation, which extends over more than five degrees of longitude and includes the breeding grounds of more than a million sea birds.

Some reservations — Breton Island, Louisiana, for instance—serve for the winter protection of waterfowl; others, as the two in North Dakota, are in the center of the best duck-breeding grounds still left in the United States. The Yukon Delta reservation includes the largest breeding colonies of ducks and geese in Alaska, and with its several hundred

Photo from Wells W. Cooke

A GROUP OF DOMESTICATED CANADA WILD GEESE LEAVING THE SHORE FOR THEIR FEEDING GROUNDS IN CHINCOTEAGUE BAY, VIRGINIA

They roam 10 to 15 miles to neighboring islands and some remain away all winter; but in spring they return to the home pastures, where for years they have reared their young thousand acres covers more territory than the entire lake region of North Dakota.

Shooting, trapping, or disturbing the birds in any manner is prohibited on all these reservations, whether they are to be nesting places in summer or refuges from man's attack during the winter.

GAME REFUGES IN LOUISIANA

The results of such local protection are often immediate and striking. In the San Luis Valley, Colorado, the safety afforded ducks on an artificial pond fed by an artesian well has induced the birds to resort there in larger and larger numbers every winter.

At Palm Beach, Florida, where no hunting is allowed within a mile of the town, ducks have become so tame that they will come for food within a few feet of a person (see cut, page 370), while outside the mile limit these same birds are so wild that it is difficult to get within gunshot range of them.

Private enterprise and generosity have joined forces with the national and State governments in extending protection to the birds. One of the most striking examples is the Ward-McIlhenny Game Refuge in southern Louisiana, in the very heart of the region already designated as the greatest winter home of ducks on the North American continent.

These two gentlemen—C. W. Ward and E. A. McIlhenny—purchased some 50,000 acres and hired game wardens at their own expense to patrol the district and prevent all shooting. Later they deeded 13,000 acres to the State of Louisiana to serve as a perpetual bird refuge (see map, page 373). This district had long been a favorite with the market gunner, and its 15 miles of now protected shore-line cannot fail to be a safe abiding place in winter for innumerable waterfowl.

Here is the principal winter home of the blue goose, one of the rarest and most interesting of North American geese (see cut, page 372). Going northward in the spring, their pathway can be traced until they reach Hudson Bay. There they disappear; the nest and eggs have never been found, and no white man has ever reported seeing a blue goose in the summer.

By exclusion and from the testimony of the natives, it is almost certain that they breed in the unexplored interior of the Labrador Peninsula. In the fall they reappear and move slowly south to the coast of Louisiana, where they are subject to increasing persecution. The Ward-McIlhenny Wildfowl Refuge, in the center of their winter range, will offer a welcome and much-needed shelter and go far toward preventing the total extinction of this rare species.

DOMESTICATION PROVED POSSIBLE

Artificial propagation is worthy of consideration. That this is feasible has been strikingly shown by J. W. Whealton, of Chincoteague Island, Virginia, who has been raising the Canada wild goose for more than 50 years, and some of his oldest and best pairs are well beyond the half-century mark; in fact, have had their golden weddings (see pages 378 and 379).

The homing instinct has become sufficiently developed for them to be trusted to feed at liberty, and the flocks, now numbering several hundred, forage on neighboring islands even 15 miles distant. No runaways have been known, and many pairs which spend the fall and winter on adjacent islands return regularly every spring to their breeding pastures and their old nests.

Even the black mallard, one of the wildest and most untamable of all waterfowl, has become semi-domesticated and has shown remarkable powers of reproduction; 1,200 ducks were raised in three years from a beginning of only 80 pairs. Mr. Whealton has also succeeded in breeding the greater snow goose, although its nest and eggs in the wild state are almost unknown.

THE NEW FEDERAL LAW

The closing hours of the last Congress were marked by the passage, late in February, of the McLean Bill for the protection of migratory game birds. This bill declares all migratory game birds "to be within the custody and protection of the government of the United States," and authorizes and directs the Department of Agriculture to prescribe and fix close seasons for their protection.

Photo from Wells W. Cooke

GREATER SNOW GEESE, ADULT AND YOUNG PAIRS: CHINCOTEAGUE, VIRGINIA

This flock is the first that has ever been raised in captivity. That artificial propagation of ducks and geese is feasible has been strikingly shown by J. W. Whealton, of Chincoteague Island, Virginia, who has been raising the Canada wild goose for more than [illegible] years. Some of his [illegible]

Photo from Wells W. Cooke

CANADA WILD GOOSE SITTING ON NEST AT THE BREEDING FARM OF J. M. WHEALTON: CHINCOTEAGUE ISLAND, VIRGINIA

This goose and her mate are over 50 years of age, and have come back to this nest voluntarily, spring after spring, for nearly half a century

This is easily the most important piece of game legislation that has ever been enacted. As the law does not go into effect until the first of July, the department has not yet promulgated its rules and regulations; but the curtailment of slaughter that is sure to follow this nation-wide attempt at game conservation cannot fail to have a marked effect in preserving and ultimately increasing the present remnants of the waterfowl.

It is exceedingly fortunate that this protective legislation has been taken in hand, for the McLean law will save our ducks and geese from the fate which has so unfortunately overtaken the passenger pigeon, which formerly existed in enormous numbers all over the country. To-day this bird is entirely extinct, the last survivor dying in the Zoo at Cincinnati a few days ago.

J. J. Audubon, in his great work, "The Birds of America," in Vol. V, page 26, writes:

"The multitudes of wild pigeons in our woods are astonishing. Indeed, after having viewed them so often and under so many circumstances, I even now feel inclined to pause and assure myself that what I am going to relate is fact. Yet I have seen it all, and that, too, in the company of persons who, like myself, were struck with amazement.

"In the autumn of 1813 I left my house at Henderson, on the banks of the Ohio, on my way to Louisville. In passing over the barrens, a few miles beyond Hardensburgh, I observed the pigeons flying from northeast to southwest in greater numbers than I thought I had ever seen them before, and feeling an inclination to count the flocks that might pass within the reach of my eye in one hour, I dismounted, seated myself on an eminence, and began to mark with my pencil, making a dot for every flock that passed. In a short time, finding the task which I had undertaken impracticable, as the birds poured on in countless multitudes, I rose, and counting the dots then put down, found that 163 had been made in 21 minutes. I traveled on and still met more the farther I proceeded. The air was literally filled with pigeons; the light of noonday was obscured as by an eclipse; the dung fell in spots, not unlike melting flakes of snow, and the continued buzz of wings had a tendency to lull my senses to repose.

"Before sunset I reached Louisville, distant from Hardensburgh 55 miles. The pigeons were still passing in undiminished numbers and continued to do so for three days in succession. The people were all in arms. The banks of the Ohio were crowded with men and boys, incessantly shooting at the pilgrims, which there flew lower as they passed the river. Multitudes were thus destroyed. For a week or more the population fed on no other flesh than that of pigeons and talked of nothing but pigeons."

FURTHER TESTIMONY

So, too, Elliott Coues, writing in 1897 in his "Key to North American Birds," Vol. II, page 712, comments on their threatened extinction thus:

"We do not now have the millions that the earlier writers speak of in the eastern United States, and no contract for service has for many years included a clause that the hireling should not be fed too often on wild pigeons or salmon; but I remember one great flight over Washington, D. C., when I was a boy, about 1858, and I witnessed in 1873 another, of countless thousands, on Red River of the North. The greatest roosts and flights we now (1897) hear of are in the upper Mississippi Valley, though some of the birds may still breed in various wooded places all along our northern border and northward to Hudson's Bay. The wild pigeon seems now a passenger to happier hunting-grounds than it or the Indian has ever found in this country in the wake of the bison and the fur seal. It has been often subjected to merciless and almost wanton destruction by hundreds of thousands at a single roost in a single season; and, if it is not entirely exterminated soon, it will be only because there are too few left to pay for persecution."

From such a fate the McLean law has saved our ducks and geese, and, as its administration will be in the hands of the U. S. Department of Agriculture, it is certain that adequate steps will be taken to conserve and increase what is undoubtedly a great national asset.

WANDERING ISLANDS IN THE RIO GRANDE

By Mrs. Albert S. Burleson

THE migratory habits of certain small bodies of land inhabiting the Rio Grande and known as "cut-offs," or "bancos," have been the occasion of protracted diplomatic correspondence and discussion between the United States and Mexico.

Their refusal to remain permanently attached to one or the other of the river's banks deprived them of a fixed legal status as either Mexican or American territory and brought about their participation in many illegal and unrighteous adventures, which in turn led to misunderstandings between the two countries.

Inherently weak by reason of a loose, sandy soil, they are an easy prey to the power of the Rio Grande, a river of unusual and striking characteristics and revolutionary action.

No one with an intimate knowledge of a great river will wonder at the homage so frequently offered it by early peoples. Its personality is so real to those who have lived by it and on it and know some of the many things it can do that they come to have a feeling akin to the blind fear and admiration expressed toward certain rivers in many acts by primitive races.

A RIVER OF UNSETTLED HABITS

In no river is spirit more evident than in the Rio Grande. From its birthplace in the snows of Colorado to where its flood meets the tides of the Gulf of Mexico, it seems a sentient intelligence, laden with messages for the country through which it passes.

Its power to do good or to withhold it is apparent in the creation of rich alluvial valleys, or when it plunges through rock-bound canyons, leaving the country for miles on either side a voiceless desert. Throughout its length it seems to brood over the land for good or for evil. Along its sinuous route below Rio Grande City it pushes i's way through miles of level sand in its final reach to the Gulf, twisting and doubling upon itself like a great sea serpent.

For centuries it had coiled and uncoiled and straightened itself again in the yielding sands of the semi-arid region, with none to heed its vagaries, until Mexico and the United States, by the Treaty of Guadaloupe Hidalgo, in the year 1848, fixed upon it as the boundary line between the two countries and thereby brought it under international supervision. Its unsettled habits were recognized, however, and in the earliest convention on the boundary question every effort was made to provide against future misunderstandings arising between the two countries because of them.

The boundary was to be the "middle of the river, following the deepest channel." This seemed clear, and took practical note of the river's shifting current, and neither side foresaw that it would not prove broad enough to cover the good intention of each to the other.

But the Rio Grande possessed characteristics that had not impressed themselves upon the framers of the convention as possible causes of friction between the people living along its banks. In addition to its eroding power, exercised through long months of low and mean water, it could during flood periods leap with torrential force across a narrow neck of land at the base of one of its long loops and cut for itself a new channel.

WHAT A BANCO IS

Through such avulsive action of the river, Texas soil would sometimes become Mexican, and on occasions a plantation occupied by jacals and Mexican citizens would over night find itself a part of Texas—and behold a banco!*

To meet this condition a new conven-

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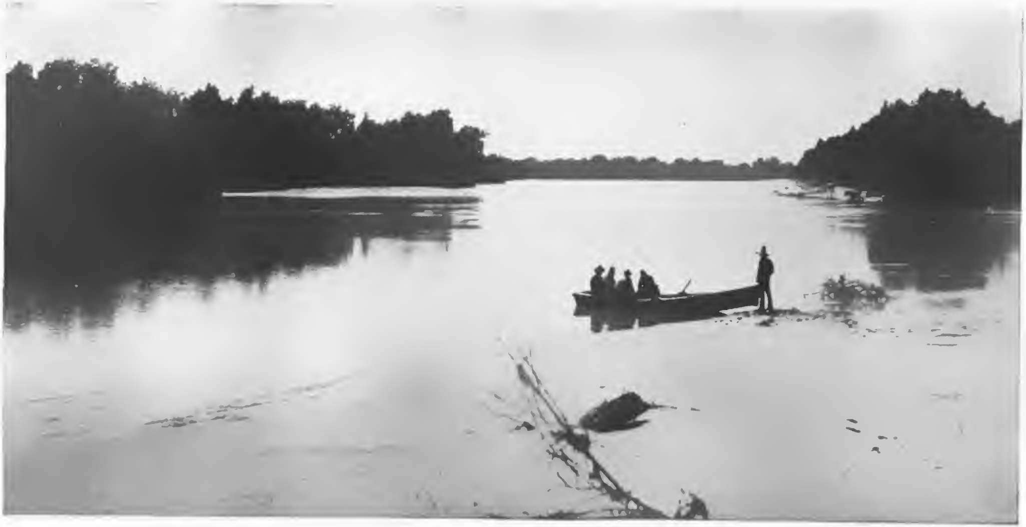
*A banco is the non-descriptive term—eluding translation, but whose nearest English equivalent is cut-off—applied to those portions of the territory thus separated from the mainland by the river.



AN ILLUSTRATION OF HOW THE RIO GRANDE FORMS A NEW BANCO

The river is flowing straight across the front of the picture, from right to left. The trees on the left are on the Mexican bank and the boat is on the American bank. The broad stream in the center of the picture was formerly the course of the river, and the trees on the right once stood on the American bank. They have now been cut to the Mexican side and, with the land on which they stand, form a new banco.

tion was negotiated, providing that no such avulsive action of the river should be permitted to change the boundary line as determined by the original survey, but that the line should "continue to follow the middle of the original channel bed, even though this should become wholly dry or be obstructed by deposits." Each banco, or cut-off, therefore, though unmoored from its mother country, was to be regarded as a part of it, with no change of allegiance or jurisdiction.

But the river still held revelations for the treaty-makers, and the carefully framed articles, which had considered natural changes in the boundary line due to "slow and gradual erosion and deposit of alluvium," and also to avulsion, "by the abandonment of an existing river bed and the opening of a new one," had not reckoned with the result of a combination of such changes.

When, after forming a banco, or cut-off, the river, by wearing into the opposite bank, would enlarge the banco by accretion, the ownership of the new land would immediately become the subject of dispute.

To whom should it belong? To the owner of the banco, or to the man whose land formerly faced the river and was now separated from it by an intruder from the other side, but whose country claimed jurisdiction to the middle of the river's channel?

HOW A RIVER WORRIED STATESMEN

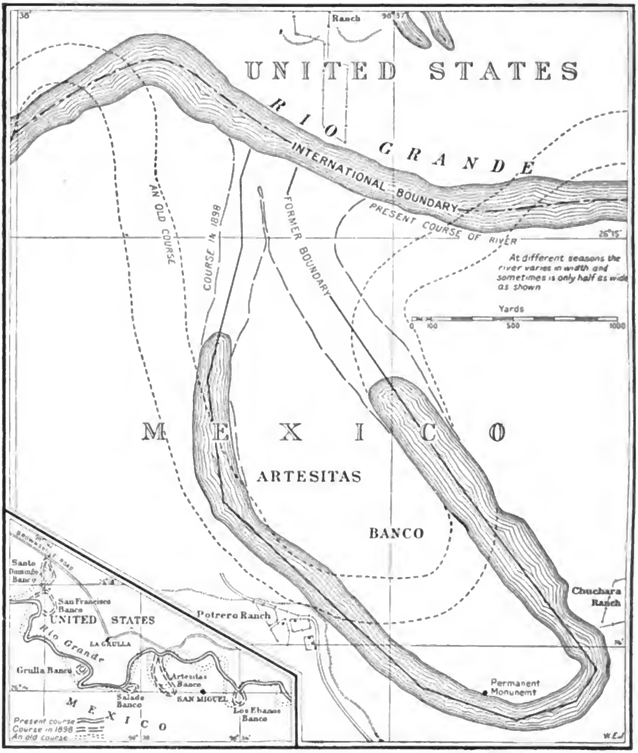
An example will serve to show both the extraordinary actions of the river and the difficulties in the way of any satisfactory adjustment of conflicting interests.

In the year 1851 a certain Josiah Turner began to farm the Galveston Ranch, on the Texan bank of the Rio Grande. In 1859 he was greatly surprised when 221 acres of Mexican land suddenly came across the river and attached itself to his ranch. An arrangement was effected by which he became the owner of this land, which is now known as the Soliseño Banco. The river was tranquil until 1865, when it cut off a piece of Mr. Turner's land and took it to Mexico, and there part of it remains to this day. The other part was gradually washed away; but in 1886 the river made up its mind to repay the farmer for what it had taken from him 21 years before, and so carried back into Texas a piece of land far larger than the tract originally lost. But, unfortunately for the good intentions of the river, the land it restored belonged to owners on the Mexican side, and although it had attached itself to Mr. Turner's land and had apparently become an inseparable part of it, the Mexican owners claimed possession.

So great was the confusion of boundary lines, the disturbance of private and public titles to lands, and so many were the conflicts of jurisdiction between the two governments following upon such freakish actions of the river, that a new convention, dealing with the questions under dispute, became necessary. To hasten action upon these and other matters related to the boundary line and threatening the amicable relations of the two countries, it was found advisable to create a boundary commission clothed with authority to investigate and determine the merits of each contest.

Composed of two members, one appointed by each country, the only limit placed upon its discretionary power was the privilege, reserved by each government, to object within 30 days to its findings. Any question upon which the commissioners failed to agree was to be referred to the state departments of their respective governments, to await final disposition through the slow process of diplomatic correspondence.

In view of the extended authority reposed in this international court and the importance and delicacy of the questions brought before it, many of them complicated by ill-feeling upon the part of the complainants, it is fortunate for this country that President Cleveland's choice of the United States Commissioner should have fallen upon Brigadier General Anson Mills, U. S. Army—a man eminently fitted to perform the duties of the position. To his fine discrimination, patience, and tact we owe the final solution of the banco problem. It seems simple, now that we have it, but when General Mills took up its consideration he found it a maze in which the diplomats of both countries



MAP TO ILLUSTRATE THE WANDERINGS OF THE RIO GRANDE AND OF THE OLD BOUNDARY

had been hopelessly wandering for years.

The initial case brought before him and his Mexican colleague in their capacity as commissioners was typical of all the others. Mexicans had been imprisoned on the American side and Americans had been imprisoned on the Mexican side; troops of both countries had been ordered out to protect its citizens; both sides claimed their laws to have been violated; neither was willing to yield jurisdiction to the other. The next step might be riot and bloodshed. This state of things, with endless variations, but always underlying it the probability of clash between the two peoples, prevailed throughout the banco region from Rio Grande City to the Gulf.

Small in area, rarely attaining to 500 acres in extent, not always arable, and rarely inhabited, many of them, indeed, mere sand banks, these bancos are yet rich in mystery and romance. About them has raged for years border conflicts that have crowded the dockets of the Texas Federal courts and piled high our official correspondence with Mexico.

Oftentimes surrounded by a deep bayou, which marks the lazy trail of the river as it followed the line of least resistance through the loose soil, the banco, like a moated castle of medieval days, has become a stronghold for murderers, thieves, and smugglers. Here criminals have been able to defy the operation of the laws of both countries. Convictions are rarely possible when witnesses are always at hand ready to swear that the banco belongs to either Mexico or the United States, as the exigencies of the case may require.

The zeal of a revenue officer oftener than not only means new difficulties—fresh strain on our relations with Mexico, with the silent work of the stiletto, perhaps, added to complicate the affair.

HOW THE PROBLEM WAS SOLVED

A resurvey of the river made by the engineers attached to the boundary commission showed these "cut-offs" in every stage of existence. Some were still surrounded by water; around others the old bed of the river, though dry, could be plainly followed; while still others showed scarcely a trace of the old channel, which had filled up with alluvium and become in some instances covered with brush or heavily timbered. Many of the bancos appearing on the map of the original survey made in 1853 were gone; many new ones and some in process of formation appeared in the new survey.

To follow this devious line and mark it as the boundary between the two countries, according to the latest treaty stipulation, would entail upon both a protracted and costly work.

Thoroughly familiar, from boyhood, with the Rio Grande and having also in later years given it the careful study of an engineer, General Mills knew that in the course of another 50 years the great, stealthy river would make still a different map—obliterating old bancos and forming new ones, sweeping away many of the boundary monuments and necessitating a repetition of the whole laborious work.

It was here that the General drew his pencil through the troublesome little "cut-offs" and sent in his recommendation to the department that they be forever eliminated from the boundary line, all those occurring on the right of the river to pass to the jurisdiction of Mexico, those on the left bank to that of Texas. The inhabitants, if any, should retain their citizenship in the country from which they had been so suddenly and violently detached, or they might acquire the nationality of the country to which the banco would now belong. Any cut-off exceeding 650 acres in area and having a population of over 200 souls was not to be considered a banco, and the old bed of the river should remain the boundary.

AN EFFECTIVE AND EQUITABLE DECISION

By this arrangement neither country suffered any appreciable loss of territory, for the bancos migrate with great impartiality from one side or the other.

The effectiveness of this plan was so apparent that it was promptly approved by our State Department. In Mexico the proposition, though heartily indorsed by the Mexican Commissioner, was held up upon the constitutional ground that the Mexican State Department had no right to cede any portion of Mexico's territory to another country, and it was referred to a Senate committee for consideration.

But legislative action followed so slowly that it was several years before Mexico, having in the meantime exhausted every possible effort to find a different way out of the difficulty, agreed to the elimination of the bancos. A convention was finally negotiated and sent to the United States Senate for ratification. There it was met by a protest from citizens of Texas living in Brownsville; and although this proved upon investigation to be nothing more than the cry of some questionable characters, whose activities in the field of smuggling would thereby be curtailed, it succeeded in delaying action upon the treaty for two years.

During the closing days of the 60th Congress the convention was at last ratified by the United States Senate. Two days later the Mexican Senate confirmed it. Today it stands in both countries as the supreme law on the much-agitated boundary question.

During the five years that have elapsed since the conclusion of the treaty a commission of American and Mexican engineers has been constantly at work surveying the river, locating new bancos, and, on the basis described above, determining to which country they belong.

At the end of December, 1912, the commission had located, surveyed, and mapped 89 bancos situated in the lower reaches of the river between Rio Grande City and its mouth. On each of these bancos a permanent monument has been erected, by means of which and the maps which have been prepared any given banco can now be identified, no matter what the action of the river may have been in the meantime.

Thus the great turbid, silt-bearing river is left to pursue its way untrammeled; but the terrors so long synonymous with its name have through the operation of this equable arrangement become a part of the storied, romantic past.

Photo by A. Y. Tugarinoff, Curator Krasnoyarsk Museum, Siberia

A LIVE SABLE IN THE MUSEUM AT KRASNOYARSK, SIBERIA

Mr. Frank N. Meyer, an agricultural explorer of the U. S. Department of Agriculture, suggests that it might be a profitable venture for Americans in the northern Rocky Mountain region to import a few pairs of the dark-skinned sables from the Krasnoyarsk district, Siberia, with a view to breeding sables in America, just as blue and silver foxes are now bred successfully in eastern Canada. The opinion among Russian hunters and fur dealers is that the sable is not a difficult animal to manage, though it is reputed very fierce, cruel, and bloodthirsty. Owing to the great decrease in the number of sables captured, the price of the skin has mounted very rapidly, and now ranges from $20 to $154 per skin. The Russian government has become so alarmed at the rapid decrease in the numbers of sable in Siberia that it has prohibited the hunting or trapping of this valuable animal for three years.

VOL. XXIV, NO. 4 WASHINGTON APRIL, 1913

THE NATIONAL GEOGRAPHIC MAGAZINE

IN THE WONDERLAND OF PERU

The Work Accomplished by the Peruvian Expedition of 1912, under the Auspices of Yale University and the National Geographic Society

BY HIRAM BINGHAM, DIRECTOR OF THE EXPEDITION

Prof. Hiram Bingham's explorations in South America, 1906–1911, and particularly his discoveries in 1911, were so important that when he was seeking funds for another Peruvian expedition in 1912, the Research Committee of the National Geographic Society made him a grant of $10,000, Yale University contributing an equal amount. His preliminary report to the National Geographic Society and Yale University of the work done in 1912 is printed herewith, and forms one of the most remarkable stories of exploration in South America in the past 50 years. The members of the Society are extremely gratified at the splendid record which Dr. Bingham and all the members of the expedition have made, and as we study the 250 marvelous pictures which are printed with this report, we also are thrilled by the wonders and mystery of Machu Picchu. What an extraordinary people the builders of Machu Picchu must have been to have constructed, without steel implements, and using only stone hammers and wedges, the wonderful city of refuge on the mountain top.—EDITOR.

INTRODUCTORY

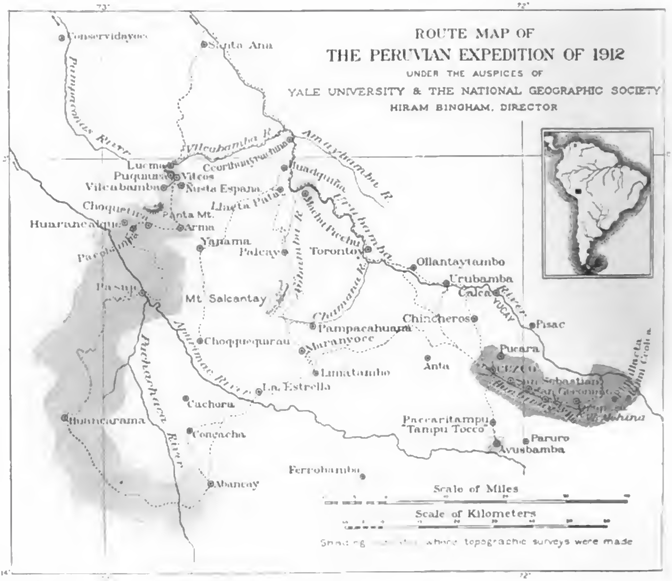
THE Peruvian Expedition of 1912, under the auspices of Yale University and the National Geographic Society, was organized with the specific purpose of carrying on the work begun by the Yale Peruvian Expedition of 1911. It was not intended to cover such a large area as had been done the year before, but to do intensive work in a part of the field where only reconnaissance work had been previously attempted.

The staff of the expedition consisted of the following: Prof. Hiram Bingham, director; Prof. Herbert E. Gregory, geologist; Dr. George F. Eaton, osteologist; Mr. Albert H. Bumstead, chief topographer; Mr. Ellwood C. Erdis, archeological engineer; Dr. Luther T. Nelson, surgeon; Messrs. Kenneth C. Heald and Robert Stephenson, assistant topographers, and Messrs. Paul Bestor, Osgood Hardy, and Joseph Little, assistants.

The director, osteologist, and the two assistant topographers left New York May 16, and were followed three weeks later by most of the others. The geologist was not able to leave until August; but as the plans for his work called for a study of a comparatively small region, the three months that he was able to spend in Peru were sufficient for his needs. Practically the entire party returned to New York in the latter part of December, after an absence of seven months.

With one exception, the members of the expedition enjoyed fairly good health during their stay in the field. An occasional acute gastritis or enteritis resulted from indiscretions in diet. Assistant Hardy and the soldier who accompanied the topographical party suffered a slight attack of malaria, but this was soon overcome by quinine.

In making a reconnaissance of the extremely inaccessible and primitive ruins



MAP OF REGION EXPLORED BY YALE-NATIONAL GEOGRAPHIC SOCIETY EXPEDITION

The dotted lines indicate the routes taken by various members of the expedition and show how thoroughly the country was covered during 1912. The shaded areas indicate the extent of the careful topographical surveys. The black spot on the little map of South America in the corner indicates the location and extent of the route map.

on the mountain of Huayna Picchu. Assistant Topographer Heald was so unfortunate as to lose his foothold on the verge of a precipice, and had a very narrow escape from death. This accident resulted in a rupture of the ligaments of his collar-bone, which later incapacitated him for some time and prevented his accomplishing the reconnaissance work in the Pampaconas Valley which had been planned.

Assistant Bestor had the misfortune to contract amœbic dysentery while on a journey in the interior. Very probably he was infected by drinking unboiled water from the Apurimac River at Pasaje. His condition failed to improve after seven weeks of treatment, and he was obliged to return to the United States. He was kindly received at Ancon Hospital, and was there put on the road to complete recovery.

We found an epidemic of smallpox and typhoid fever raging in the towns of Arma, Puquiura, and Lucma. These towns of 150 to 200 inhabitants had had a death toll of 40 and 50 people each.

There was very little opportunity for medical work among the native Indians, but the more educated Peruvians were extremely glad to come to the free clinics.

There are no physicians in most of the villages of the interior; consequently the owners of the large plantations have to rely entirely on their own efforts at

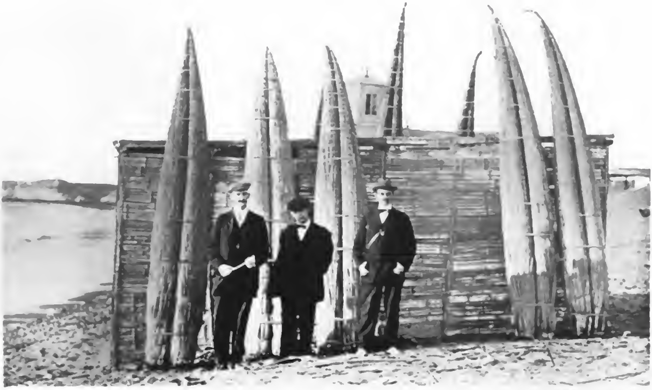


Photo by Hiram Bingham

STRAW BOATS ON THE BEACH AT PACASMAYO, PERU

On their way to southern Peru the members of the expedition touched at various ports, including Pacasmayo, where the fishermen use a peculiar form of canoe. These canoes, or *balsas*, are made of rushes and have to be dried out each time they are used. The picture also shows a typical fisherman's hut made of split bamboo.

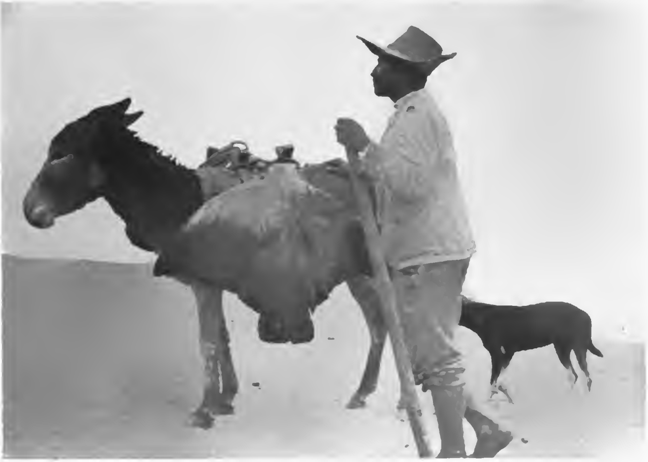


Photo by Hiram Bingham

A FISHERMAN AND HIS CATCH AT SALAVERRY, PERU

Another port at which the expedition touched was Salaverry. Here they met a fisherman and his *burro* bringing in two large skates, called *rayas,* which they were taking to sell in the Salaverry market.

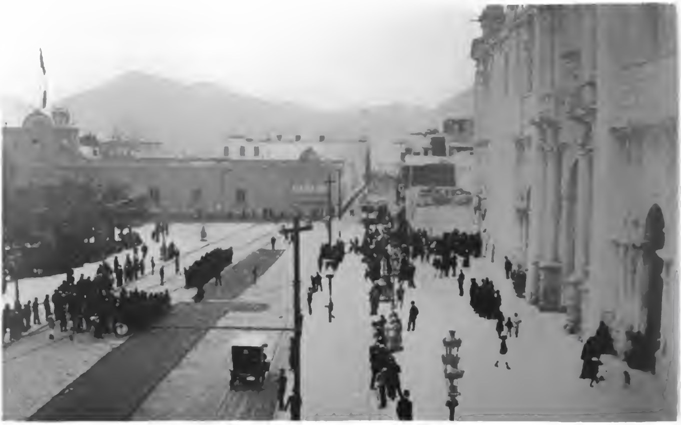


Photo by Hiram Bingh

IN FRONT OF THE CATHEDRAL: LIMA, PERU

The first part of the expedition arrived in Lima just in time to witness the annual procession of Corpus Christi. Starting from the cathedral, shown at the right, the procession, made up largely of little children in attractive costumes, passed around the four sides of the principal plaza and returned to the cathedral. This picture, taken before the procession started, shows the military band and escort, and the carpet of flowers and green leaves over which the procession was to pass.

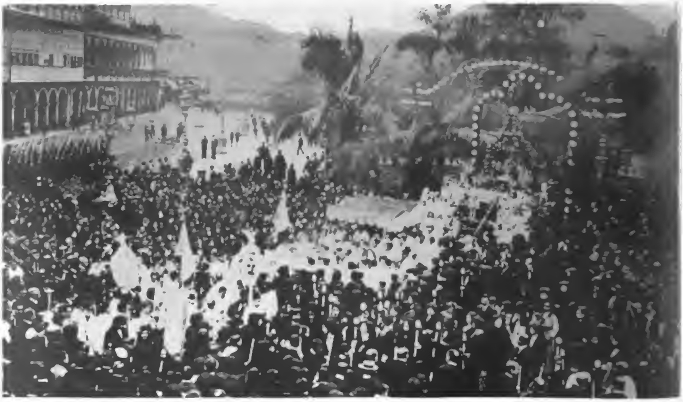


Photo by Hiram Bing

CORPUS CHRISTI PROCESSION: LIMA, PERU

On one of the corners of the plaza a temporary altar, elaborately decorated, had been erected and here the Corpus Christi procession stopped while Benediction was given curing diseases among the Indians in their employ. Very few Peruvians are properly vaccinated.

STRANGE MODE OF VACCINATION

The Indians believe that vaccination with pus from the lesions of a patient who has died with smallpox confers immunity from the disease. They practice this sort of vaccination, with the result that many who are thus inoculated die from the disease.

There is no attempt made to isolate the smallpox or typhoid patients. Neighbors mingle freely in the huts where the diseases exist, and at the funeral of the dead they have feasts in which every one partakes, many using common cups and dishes. The clothes of the dead are washed in the same stream from which the people in the villages get their drinking water. There are no windows in the highland huts, and there is no attempt at cleanliness in the dark interiors. Of course, fumigation is unknown and vermin abound.

On many of the large plantations conditions are better. There the owners of the estates vaccinate their Indian tenants and laborers. In some of the villages a priest will vaccinate a few during his annual or semi-annual visit, so that some do get the benefit of protection from smallpox. In the cities, on the other hand, while many are vaccinated, there are many who are not, so that even in Cuzco smallpox was raging during our stay; and, furthermore, practically no attempt was being made at isolation or any other measure to prevent the spread of the epidemic.

Notwithstanding many hardships and the presence of a considerable amount of illness in southern Peru, all the members of our party worked hard and faithfully, and the general results of the expedition were highly satisfactory.

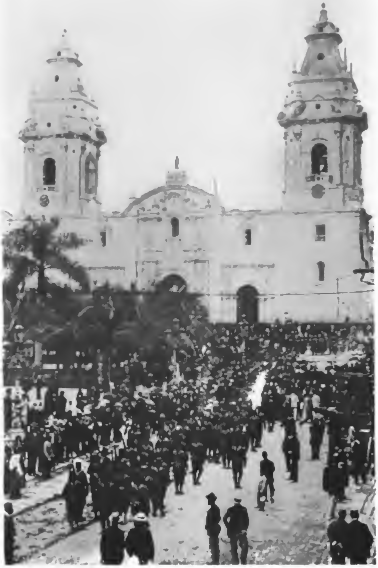


Photo by Hiram Bingham

CORPUS CHRISTI PROCESSION: LIMA, PERU

After Benediction had been given on the corner of the plaza, the procession moved slowly toward the cathedral. The "conflict of old and new" is vividly emphasized in this picture, where the repair wagon of the trolley line is seen at the right only a few feet from this religious procession so redolent of the middle ages. The towers of the cathedral are made of plaster and lath. In this land of earthquakes it was not considered safe to build them of stone.

RESULTS ACHIEVED BY THE EXPEDITION

The work actually accomplished may be grouped under the following heads: (1) Machu Picchu; its archeology and osteology, and the topography and forestration of the surrounding region (see pages 402 to 517).

(2) The Cuzco region; its geology, osteology, and topography, with special reference to the age of its vertebrate remains (see pages 490 to 506).

Photo by Hiram Bingham

LLAMAS AT SANTA ROSA STATION, SOUTHERN PERU

In order to reach the field of operations and Cuzco, the base of supplies, the expedition went from the port of Mollendo by rail to Juliaca near Lake Titicaca and thence north to Cuzco. On the way, near the railroad stations herds of llamas were frequently seen. Sometimes, as in this case, their packs had just been removed and may be seen in the lower left-hand corner of the picture. The variegated markings of the different animals [illegible] "American camel" has been.

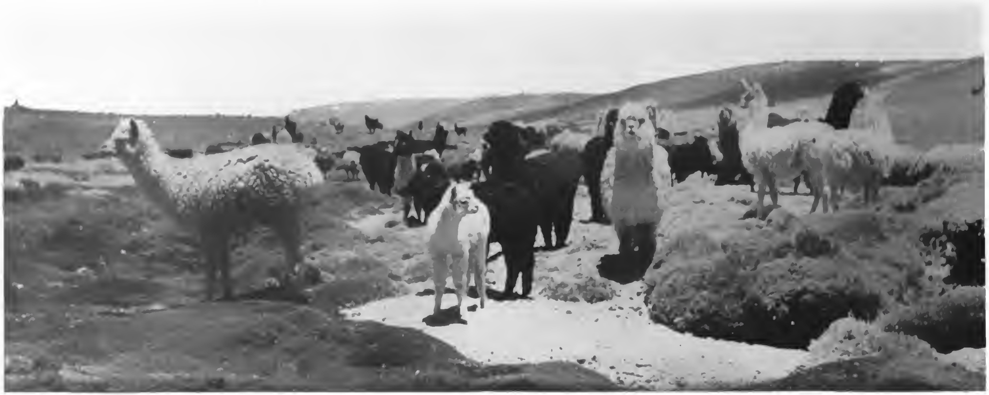


Photo by Hiram Bingham

ALPACAS AND LLAMAS

On the high upland pastures between Lake Titicaca and Cuzco thousands of alpacas and llamas find their natural feeding grounds. They have been domesticated for centuries, and do not exist in a wild state, but are always attended by shepherds. Alpaca wool is one of the choicest exports of Peru.

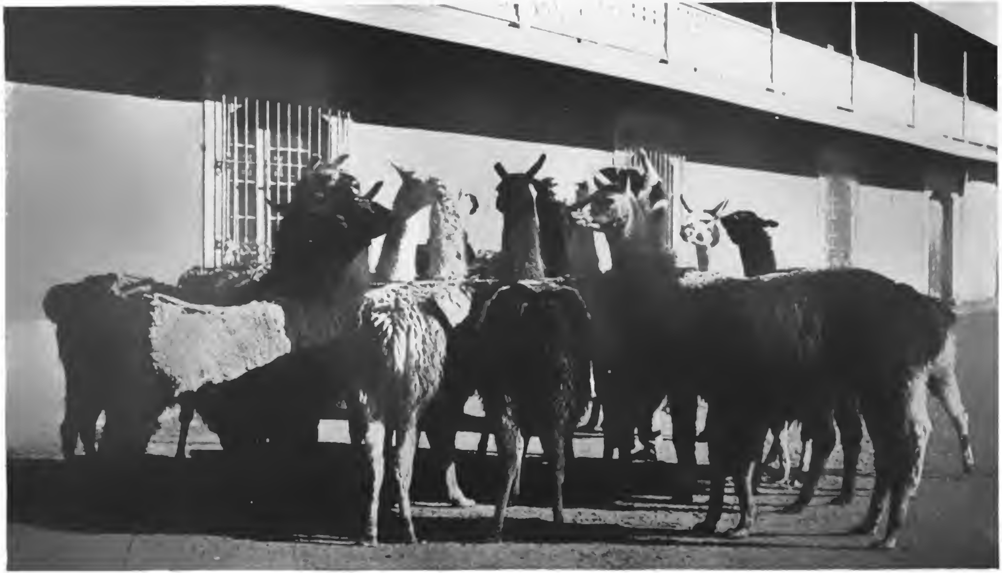


Photo by H. W. Foote

THIS PICTURE ILLUSTRATES HOW LLAMAS ARE TETHERED IN PERU

The llama has so little ordinary intelligence and so great a desire to maintain its proper social standing that a group of llamas may be secured, as is shown in the picture, by a single rope, passed around outside their stiffly erected necks. By merely lowering their heads they could all escape.

Photo by H. L. Tucker

A TYPICAL PERUVIAN PLAZA

The llamas are loaded with rock-salt. The open sewer in the center of the street is characteristic of many mountain towns

(3) A contour map from Abancay to Puquiura, completing the topography of the cross-section from Camaná, on the Pacific Ocean, to canoe navigation on the Urubamba, begun in 1911 (see map, page 388, and pages 506 to 510).

(4) The topography and archeology of Vitcos and vicinity (see pages 511 to 520).

(5) The identification of ancient Inca place names of Vilcabamba that occur in the Spanish chronicles, but do not appear on any known maps (see page 520).

(6) An archeological and topographical reconnaissance of the hitherto-unexplored Aobamba Valley (see pages 520 to 544).

(7) A reconnaissance of the northern route to Choqquequirau and a brief osteological and archeological reconnaissance of that city (see pages 544 to 561).

(8) An anthropological study of the highland Indians of southern Peru, including the careful anthropometric measurement of 145 individuals (see pages 561 to 564).

(9) The taking of weather observations on the road and in the camps and the establishment at widely different elevations of four meterological stations along the 71st meridian west of Greenwich (see pages 564 and 565).

(10) The collection, wherever practicable, of paleontological, osteological, ethnological, and archeological material (see page 567).

The following report takes up these subjects in the order named.

Photo by H. L. Tucker

A LLAMA CARAVAN UNDER FULL SPEED

On long journeys llamas must be driven carefully and very slowly and allowed to take frequent rests. They rarely average more than ten miles a day. No fodder is carried for them. Accordingly they have to nibble by the wayside.

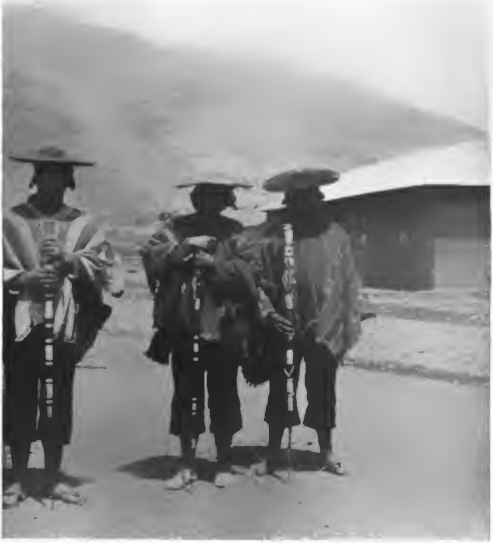


Photo by L. T. Nelson

A GROUP OF INDIAN ALCALDES: SOUTHERN PERU

Near Checcacupe Station was a group of Indian Alcaldes bearing their staffs of office decorated with bands of silver. The Alcalde is the native Indian official who stands between the local government magistrate and the natives of his village, or of his section of a city. They do no manual labor, but frequently have anything but an easy time.

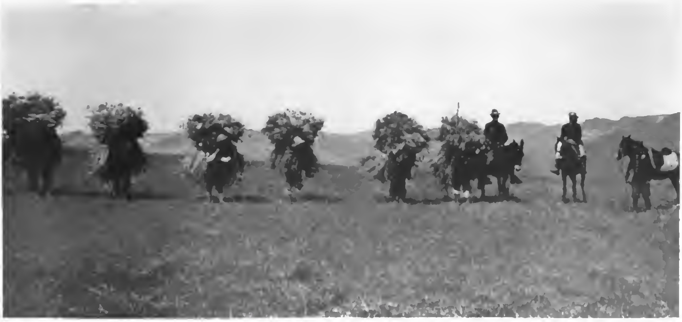


Photo by Hiram Bingham

BRINGING IN THE SHEAVES: CUZCO, PERU

Nearly all of the manual labor in southern Peru is done by native Indians who speak Quichua, the language of the Incas. Here they are seen harvesting a barley crop, taking the sheaves to the threshing floor, where cattle and horses are still used in treading out the corn.

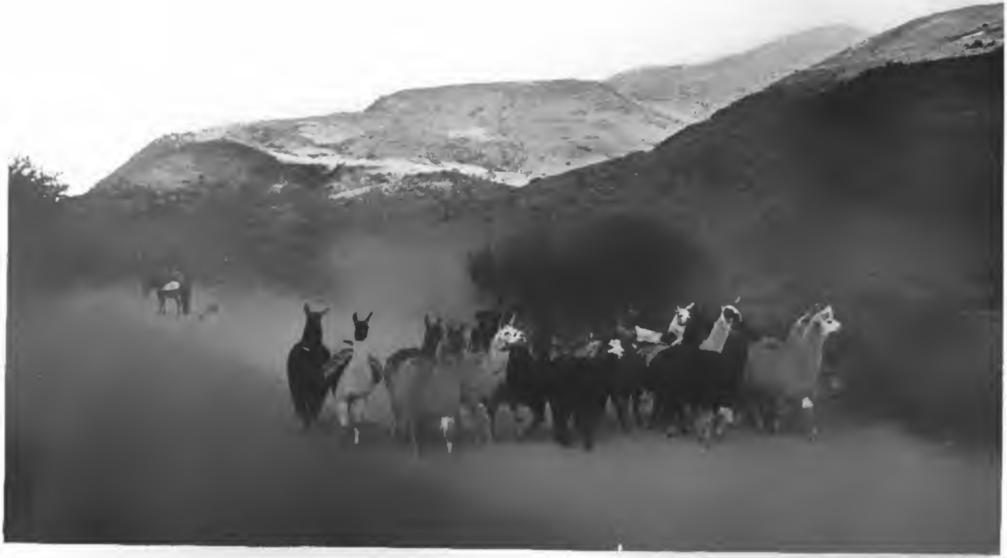


Photo by Hiram Bingham

A LLAMA TRAIN ON THE RUN: CUZCO VALLEY

Llamas are still used to a considerable extent by the Peruvian Indians as beasts of burden, but they rarely go as fast as this llama train, which was being hurried to Cuzco at a most unusual speed. Llamas are seldom given more than eighty or ninety pounds to carry

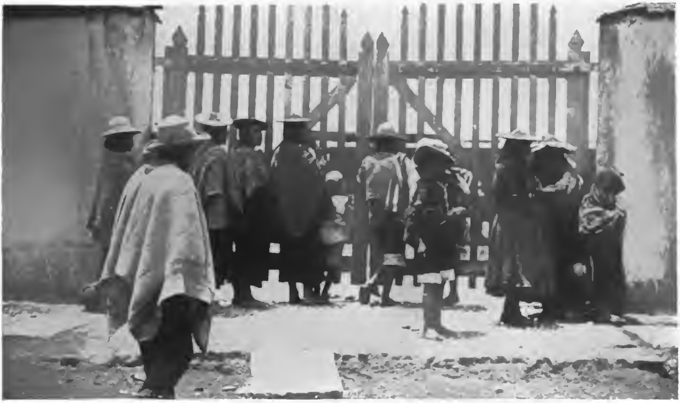


Photo by L. T. Nelson

A SCENE AT SICUANI STATION, SOUTHERN PERU

At the railway stations between Lake Titicaca and Cuzco there were invariably groups of picturesquely clad Indians nearly always wearing a poncho, and sometimes felt hats, but more often the gaudily decorated reversible pancake-hat characteristic of this part of Peru.

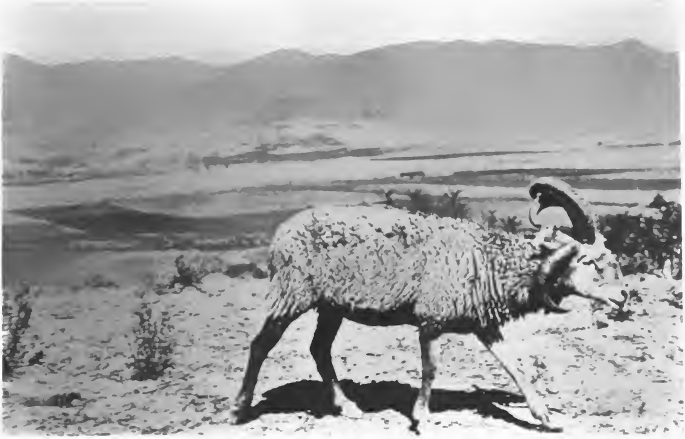


Photo by Hiram Bingham

A FOUR-HORNED SHEEP: CUZCO, PERU

In the Cuzco Valley may be seen many flocks of sheep. Most of them are of poor quality and they do not compare favorably with the blooded stock in Argentina. A not uncommon sight in the Cuzco herds is an occasional four-horned ram.

Photo by Hiram Bingham

A TYPICAL MOUNTAINEER'S HUT: SOUTHERN PERU

It was sometimes necessary to camp very close to the Indians' huts, as there was so little available flat land in many of the valleys. In such cases a family group was almost sure to gather and satisfy their curiosity as to the ways of these visiting explorers.

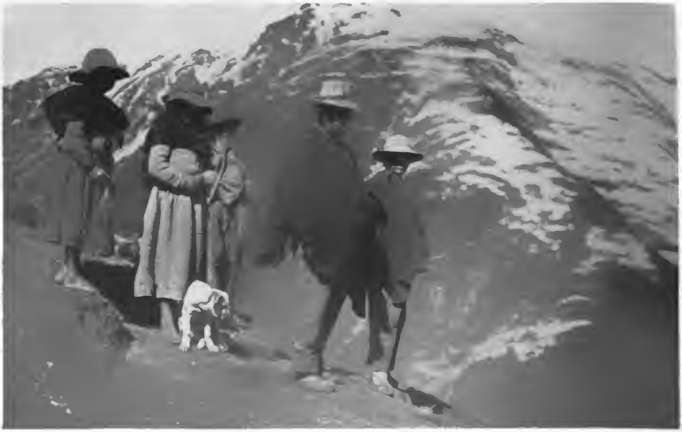


Photo by Hiram Bingham

GROUP OF MOUNTAIN INDIANS: SOUTHERN PERU

The Mountain Indians were always interested in our work and usually were content to silently watch the passage of our caravans, or quietly speculate on the activities of the topographical engineer. Once, however, the chief topographer was attacked by a dozen excited Indians who thought that he and his assistant were working some devilment with their strange instruments. Fortunately by diplomatic means they were dissuaded from doing any harm. Note the bare feet of the women at this great altitude, which is over 14,000 feet.

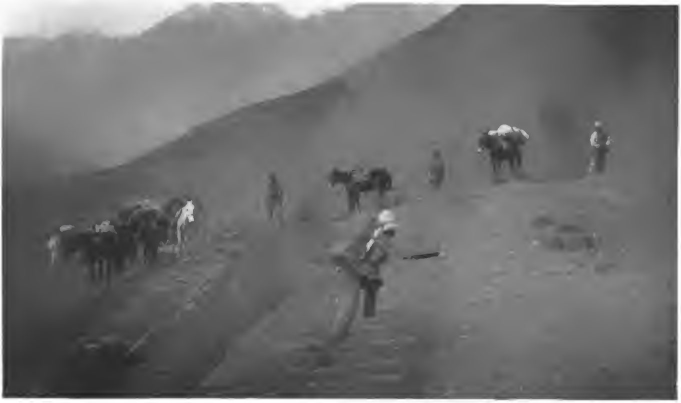


Photo by Hiram Bingham

CARRYING ADOBE BLOCKS: SOUTHERN PERU

The modern method of building a house in Cuzco and in the uplands of Peru is to begin by making a sufficient number of adobe bricks (sundried mud mixed with straw or rubbish). They are made just about as large as can be conveniently carried by one workman. In this case they were intended for the local magistrate's new house near Choquetira.

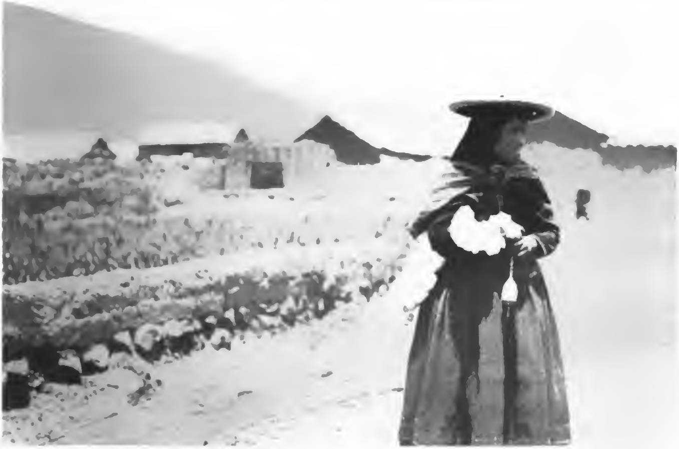


Photo by L. T. Nelson

A TYPICAL PERUVIAN INDIAN WOMAN AT QUIQUIJANA, SOUTHERN PERU

Indian women in Peru are never idle. Even when walking along the roads they are almost always engaged in spinning with old-fashioned whirl-bobs and spindles such as their ancestors used over a thousand years ago.

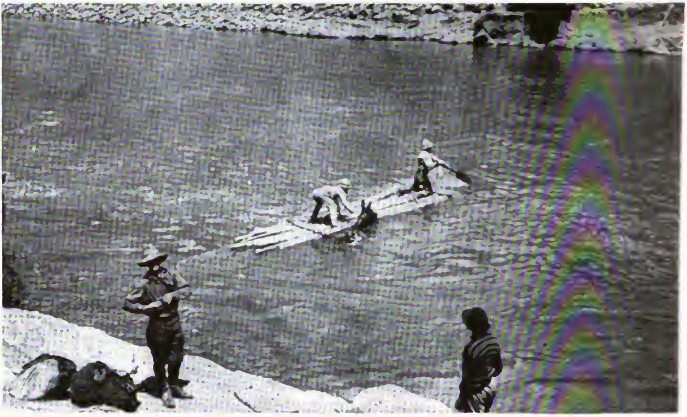


Photo by Hiram Bingham

CROSSING THE APURIMAC RIVER

Among the many hardships encountered by the expedition was the difficulty of fording the rivers under adverse circumstances. In this case, at Pasaje on the Apurimac, there was no wood in the immediate vicinity available for rafts, and it was necessary to wait several hours before the local ferryman, who lived more than a mile away on the wrong side of the river, could be aroused by firing of shots to bring his ancient raft to our assistance.

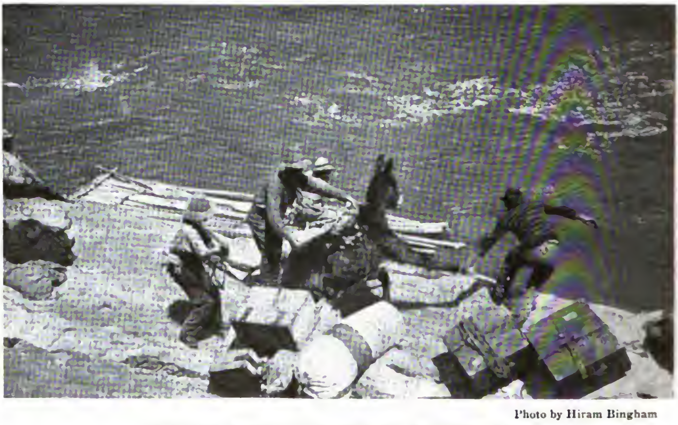


Photo by Hiram Bingham

TROUBLES WITH THE TRANSPORT: SOUTHERN PERU

Even after we had the raft our troubles were not at an end, for our mules strenuously objected to jumping off the rocks into the deep and rapid current

I.

THE CITY OF MACHU PICCHU, THE CRADLE OF THE INCA EMPIRE

In 1911, while engaged in a search for Vitcos, the last Inca capital, I went down the Urubamba Valley asking for reports as to the whereabouts of ruins.

The first day out from Cuzco saw us in Urubamba, the capital of a province, a modern town charmingly located a few miles below Yucay, which was famous for being the most highly prized winter resort of the Cuzco Incas. The next day brought us to Ollantaytambo, vividly described by Squier in his interesting book on Peru. Its ancient fortress, perched on a rocky eminence that commands a magnificent view up and down the valley, is still one of the most attractive ancient monuments in America.

Continuing on down the valley over a newly constructed government trail, we found ourselves in a wonderful cañon. So lofty are the peaks on either side that although the trail was frequently shadowed by dense tropical jungle, many of the mountains were capped with snow, and some of them had glaciers. There is no valley in South America that has such varied beauties and so many charms.

Not only has it snow-capped peaks, great granite precipices, some of them 2,000 feet sheer, and a dense tropical jungle; it has also many reminders of the architectural achievements of a bygone race. The roaring rapids of the Urubamba are frequently narrowed by skillfully constructed ancient retaining walls. Wherever the encroaching precipices permitted it, the land between them and the river was terraced. With painstaking care the ancient inhabitants rescued every available strip of arable land from the river. On one sightly bend in the river, where there is a particularly good view, and near a foaming waterfall, some ancient chief built a temple whose walls, still standing, only serve to tantalize the traveler, for there is no bridge within two days' journey and the intervening rapids are impassable. On a precipitous and well-nigh impregnable cliff, walls made of stones carefully fitted together had been placed in the weak spots, so that the defenders of the valley, standing on the top of the cliff, might shower rocks on an attacking force without any danger of their enemies being able to scale the cliff (see pages 405 and 419).

The road, following in large part an ancient footpath, is sometimes cut out of the side of sheer precipices, and at others is obliged to run on frail brackets propped against the side of overhanging cliffs. It has been an expensive one to build and will be expensive to maintain. The lack of it prevented earlier explorers from penetrating this cañon. Its existence gave us the chance of discovering Machu Picchu (see pages 405, 420, 421, 423).

On the sixth day out from Cuzco we arrived at a little plantation called Mandorpampa. We camped a few rods away from the owner's grass-thatched hut, and it was not long before he came to visit us and to inquire our business. He turned out to be an Indian rather better than the average, but overfond of "fire-water." His occupation consisted in selling grass and pasturage to passing travelers and in occasionally providing them with ardent spirits. He said that on top of the magnificent precipices near by there were some ruins at a place called Machu Picchu, and that there were others still more inaccessible at Huayna Picchu, on a peak not far distant from our camp. He offered to show me the ruins, which he had once visited, if I would pay him well for his services. His idea of proper payment was 50 cents for his day's labor. This did not seem unreasonable, although it was two and one-half times his usual day's wage.

Leaving camp soon after breakfast I joined the guide, and, accompanied by a soldier that had been kindly loaned me by the Peruvian government, plunged through the jungle to the river bank, and came to a shaky little bridge made of four tree trunks bound together with vines and stretching across a stream only a few inches above the roaring rapids.

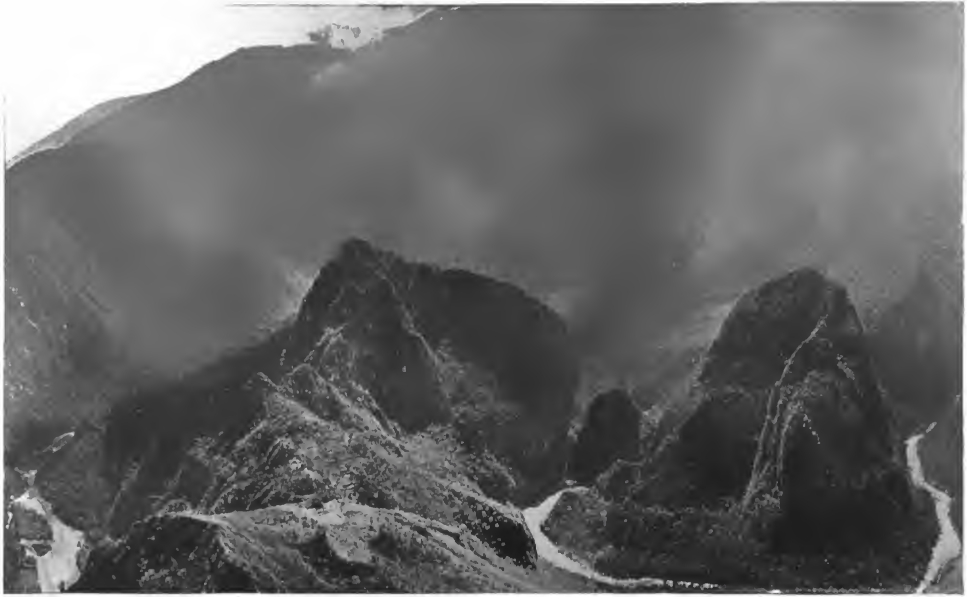


Photo by Hiram Bingham

BIRD'S-EYE VIEW OF MACHU PICCHU (DURING CLEARING) AND THE URUBAMBA CAÑON

On top of the ridge at the foot of the hill called Huayna Picchu and protected on all sides by precipices and on three sides by the rapids of the Urubamba River, the wonderful Inca city of Machu Picchu, discovered in 1911, was one of the principal scenes of action of the Peruvian Expedition of 1912. The mountains in the distance forming the fringe of the Grand Cañon of the Urubamba are from five to seven thousand feet above the river, which at this point is six thousand feet above the sea.

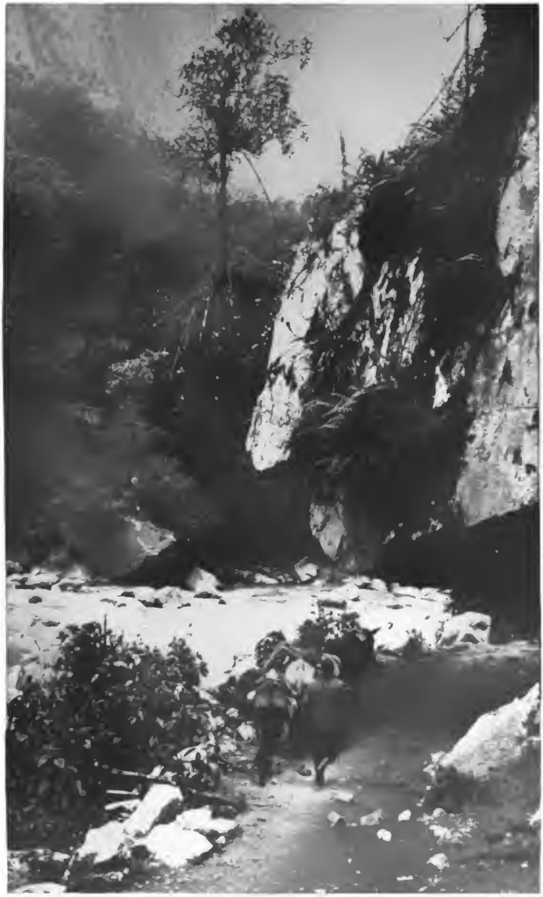


Photo by Hiram Bingham

A BIT OF THE ROAD NEAR MACHU PICCHU: URUBAMBA RIVER

The surroundings of Machu Picchu are remarkably wild and the scenery is inexpressibly beautiful. The city lies above the precipices which show in the distance in this picture. The road in the foreground was constructed a few years ago at great expense by the Peruvian government. Early explorers, being obliged to avoid this portion of the Urubamba Valley by the absence of any road, were unaware of the whereabouts of Machu Picchu, although rumors of its existence had reached the ears of a French explorer forty years ago.

Photo by Hiram Bingham

THE URUBAMBA CAÑON

A part of the Urubamba Cañon as seen from the top of Machu Picchu Mountain, 4,000 feet above the river

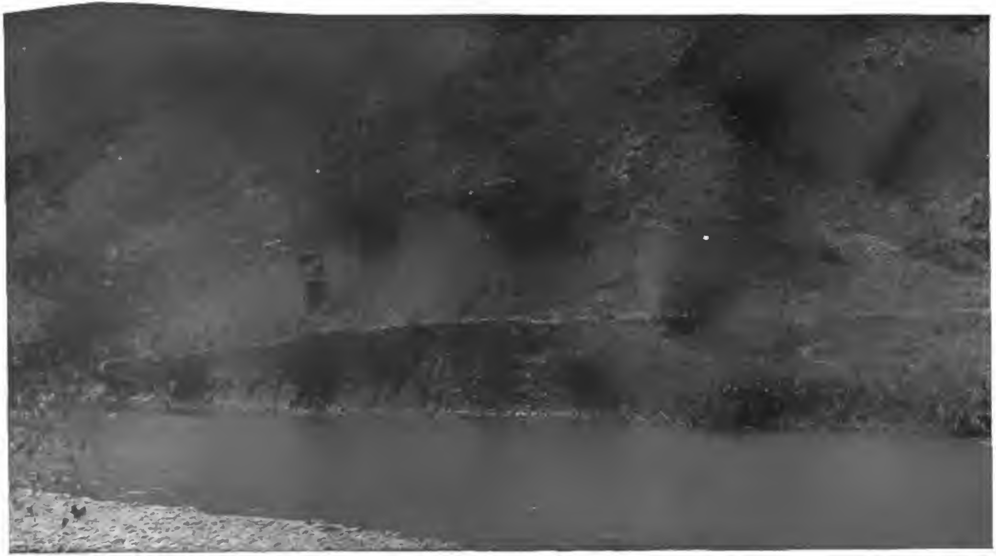


Photo by Hiram Bingham

AN ANCIENT FORTRESS NEAR OLLANTAYTAMBO: URUBAMBA VALLEY

The Urubamba Valley contains many remains of Inca architecture. This ancient fortress is on the west side of the Urubamba River near Ollantaytambo, one of the most celebrated Inca towns in the Andes. It was first graphically described in English by the late E. G. Squier, in Chapter XXIV of his "Peru."

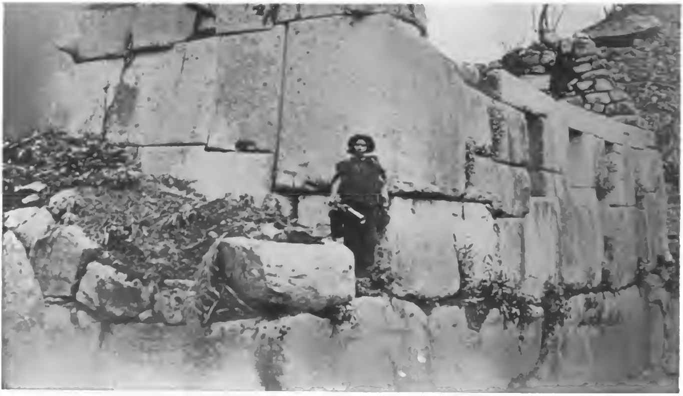


Photo by Hiram Bingham

THE TEMPLE OF THE THREE WINDOWS: MACHU PICCHU

It was this extraordinary temple, whose most characteristic feature is three large windows, a unique occurrence in early Peruvian architecture, that led us to the belief that Machu Picchu might be Tampu Tocco, the mythical place from which the Incas came when they started out to found that great empire which eventually embraced a large part of South America (see also pages 410, 414, 431, and 489).

On the other side we had a hard climb; first through the jungle and later up a very stiff, almost precipitous, slope. About noon we reached a little grass hut, where a good-natured Indian family who had been living here for three or four years gave us welcome and set before us gourds full of cool, delicious water and a few cold boiled sweet potatoes.

Apart from another hut in the vicinity and a few stone-faced terraces, there seemed to be little in the way of ruins, and I began to think that my time had been wasted. However, the view was magnificent, the water was delicious, and the shade of the hut most agreeable. So we rested a while and then went on to the top of the ridge. On all sides of us rose the magnificent peaks of the Urubamba Cañon, while 2,000 feet below us the rushing waters of the noisy river, making a great turn, defended three sides of the ridge, on top of which we were hunting for ruins. On the west side of the ridge the three Indian families who had chosen this eagle's nest for their home had built a little path, part of which consisted of crude ladders of vines and tree trunks tied to the face of the precipice.

Presently we found ourselves in the midst of a tropical forest, beneath the shade of whose trees we could make out a maze of ancient walls, the ruins of buildings made of blocks of granite, some of which were beautifully fitted together in the most refined style of Inca architecture. A few rods farther along we came to a little open space, on which were two splendid temples or palaces. The superior character of the stone work, the presence of these splendid edifices, and of what appeared to be an unusually large number of finely constructed stone dwellings, led me to believe that Machu Picchu might prove to be the largest and most important ruin discovered in South America since the days of the Spanish conquest.

A few weeks later I asked Mr. H. L. Tucker, the engineer of the 1911 Expedition, and Mr. Paul Baxter Lanius, the assistant, to go to Machu Picchu and spend three weeks there in an effort to partially clear the ruins and make such a map as was possible in the time at their disposal. The result of this work confirmed me in my belief that here lay a unique opportunity for extensive clearing and excavating.

The fact that one of the most important buildings was marked by three large windows, a rare feature in Peruvian architecture, and that many of the other buildings had windows, added to the significant circumstance that the city was located in the most inaccessible part of the Andes, inclined me to feel that there was a chance that Machu Picchu might prove to be Tampu Tocco, that mythical place from which the Incas had come when they started out to found Cuzco and to make the beginnings of that great empire which was to embrace a large part of South America.

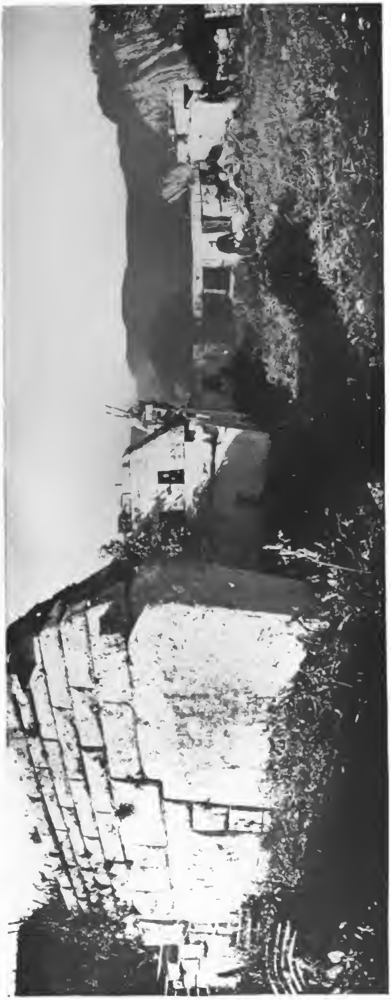


Photo by Hiram Bingham

THE SACRED PLAZA: MACHU PICCHU

The presence at Machu Picchu of these splendid temples and palaces, the superior character of the stone work, and the unusually large number of finely constructed stone dwellings, inclines us to believe that Machu Picchu is the largest and most important ruin discovered in South America since the days of the Spanish conquest. This picture shows the Sacred Plaza, the Temple of the Three Windows (behind the man), and, at the left, the Chief Temple, the most imposing structure in the city (see pages 431 and 408).

AN ANCIENT INCA TRADITION

A story told to some of the early Spanish chroniclers in regard to that distant historical event runs somewhat as follows:

Thousands of years ago there lived in the highlands of Peru a megalithic folk who developed a remarkable civilization, and who left, as architectural records, such cyclopean structures as the fortresses of Sacsahuaman and Ollantaytambo. These people were attacked by barbarian hordes coming from the south—possibly from the Argentine pampas. They were defeated, and fled into one of the most inaccessible Andine cañons. Here, in a region strongly defended by nature, they established themselves; here their descendants lived for several centuries. The chief place was called Tampu Tocco. Eventually regaining their military strength and becoming crowded in this mountainous valley, they left Tampu Tocco, and, under the leadership of three brothers, went out of three windows (or caves) and started for Cuzco.*

The migration was slow and deliberate. They eventually reached Cuzco, and there established the Inca kingdom, which through several centuries spread by conquest over the entire plateau, and even as far south as Chile and as far north as Ecuador.

This Inca empire had reached its height when the Spaniards came. The Spaniards were told that Tampu Tocco was at a place called Pacaritampu, a small village a day's journey southwest of Cuzco and in the Apurimac Valley. The chroniclers duly noted this location, and it has been taken for granted ever since that Tampu Tocco was at Pacaritampu.

THE SIGNIFICANCE OF "WINDOWS"

Tampu means "tavern," or "a place of temporary abode." Tocco means "window." The legend is distinctly connected with a place of windows, preferably of three windows, from which the three brothers, the heads of three tribes or clans, started out on the campaign that founded the Inca empire.

So far as I could discover, few travelers have ever taken the trou-

Photo by Hiram Bingham

THE URUBAMBA VALLEY AND THE ROAD TO CUZCO

This part of the Urubamba Valley is sometimes called Yucay. The climate is most delightful, and the scenery as fine as anything in South America

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* See Markham's "Incas of Peru," Chapter IV.

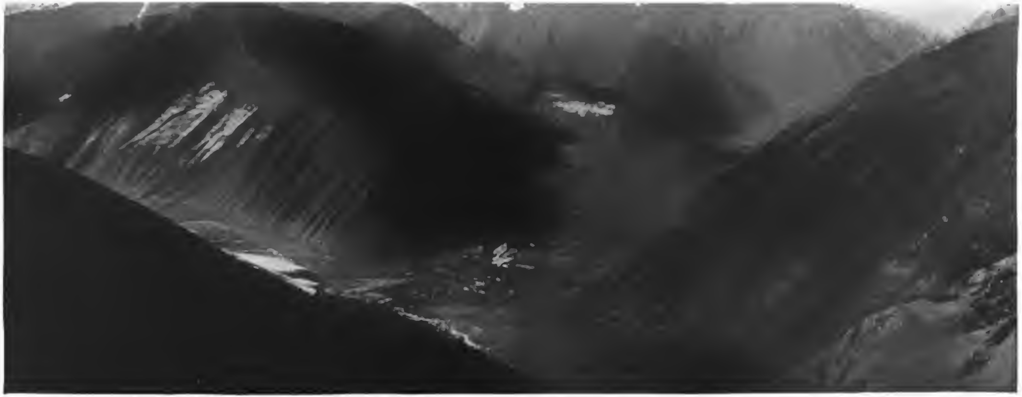


Photo by Hiram Bingham

YUCAY, THE LOVELIEST SPOT IN SOUTHERN PERU

The beautiful valley of Yucay was that portion of the Urubamba Valley most favored by the Incas of Cuzco for their country houses. This view is unsurpassed for beauty or grandeur by any in Peru, and by few in the world. There is every gradation of color and depth of shadow from the dense blue of the tropical sky past the glittering crests of the glacier-clad Andes down to the exquisite green terraces of the famous gardens of Yucay. Although the bottom of the valley is 9,000 feet above the sea, it enjoys a climate not unlike that of the south of France. The Incas, ever appreciative of beautiful views, built some of their country houses on the most sightly points of this wonderful valley.

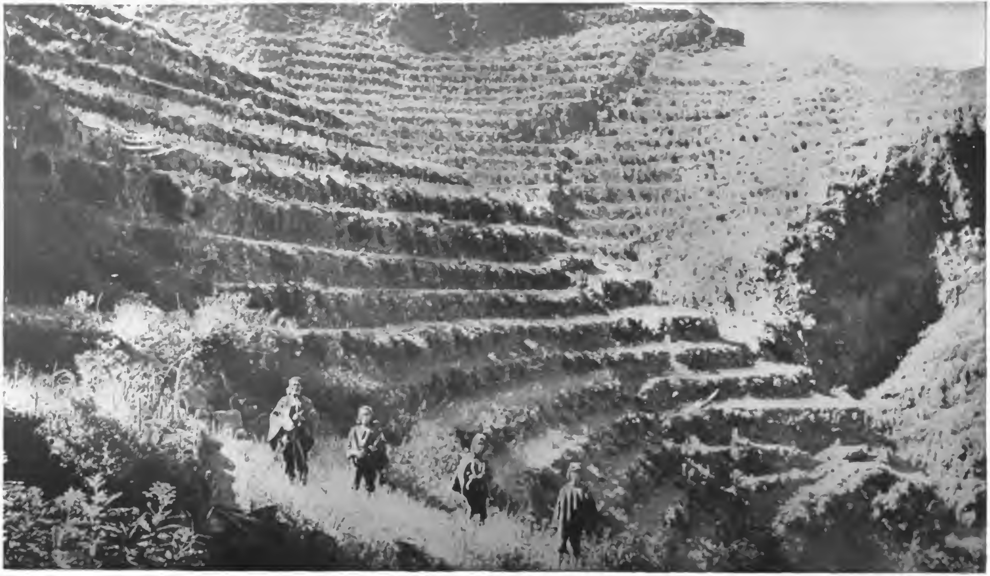


Photo by H. L. Tucker

THE ANCIENT TERRACES AT PISAC

At the upper end of the Yucay Valley are the ruins of a wonderful Inca temple, or citadel, called Pisac. One of the best descriptions of this well known and important place is in Squier's "Peru," Chapter XXV

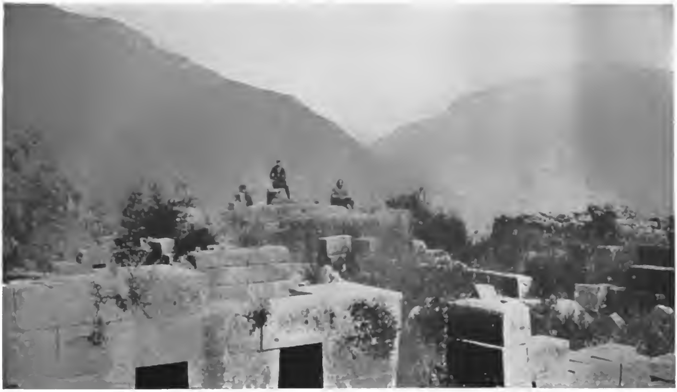


Photo by H. L. Tucker

THE RUINS OF PISAC

A nearer view of part of these remarkable ruins, which resemble in the care and exquisite finish of the stone-cutting the best ruins at Machu Picchu and in Cuzco

Photo by H. L. Tucker

LLAMAS IN THE YUCAY VALLEY

The llamas are carrying bundles of fire-wood. The total cargo of each llama is worth about 20 cents. The llama is valued at about $3.00. Back of the trees on either side of the road are fruit orchards interspersed with acres of strawberry fields. This valley is the garden spot of southern Peru. The climate is like that of California.

Photo by Hiram Bingham

A BIT OF OLLANTAYTAMBO, SOUTHERN PERU

On top of the crag, which overlooks the little village of Ollantaytambo, the Incas and their predecessors built a remarkable fortress. Some of the single stones used in the construction of this fortress weigh over eight tons.

ble to visit Pacaritampu, and no one knew whether there were any buildings with windows, or caves, there.

It was part of our plan to settle this question, and Dr. Eaton undertook the reconnaissance of Pacaritampu. He reports the presence of a small ruin, evidently a kind of rest-house or tavern, pleasantly located in the Apurimac Valley, but not naturally defended by nature and not distinguished by windows. In fact, there are neither windows nor caves in the vicinity, and the general topography does not lend itself to a rational connection with the tradition regarding Tampu Tocco (see page 415).

The presence at Machu Picchu of three large windows in one of the most conspicuous and best-built structures led me to wonder whether it might not be possible that the Incas had purposely deceived the Spaniards in placing Tampu Tocco southwest of Cuzco when it was actually north of Cuzco, at Machu Picchu.

The Incas knew that Machu Picchu, in the most inaccessible part of the Andes, was so safely hidden in tropical jungles on top of gigantic precipices that the Spaniards would not be able to find it unless they were guided to the spot. It was naturally to their advantage to conceal the secret of the actual location of Tampu Tocco, a place which their traditions must have led them to venerate. The topography of the region meets the necessities of the tradition: The presence of windows in the houses might readily give the name Tampu Tocco, or "place of temporary residence where there are windows," to this place, and the three conspicuous windows in the principal temple fits in well with the tradition of the three brothers coming out of three windows.

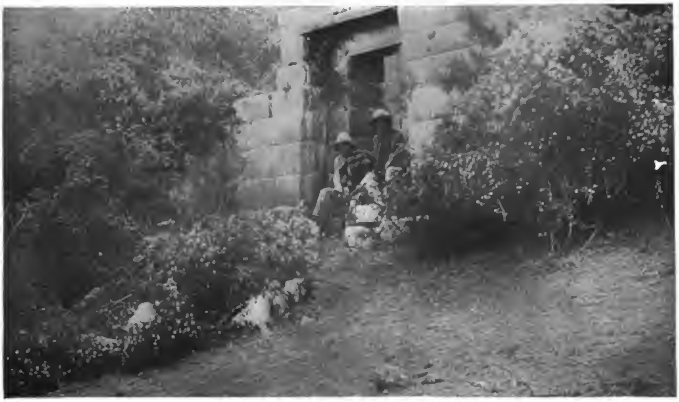


Photo by G. F. Eaton

THE RUINS OF MAUCALLACTA, NEAR PACARITAMPU

A small ruin pleasantly located in the Apurimac Valley. This is the principal ruin of the little group which the Incas made the Spaniards believe was the home of their ancestors. The surrounding country is not naturally defended and the ruins are not distinguished by windows. In other words, this ruin does not fit in with the traditions as described in the text (see pages 409, 410, and 414).

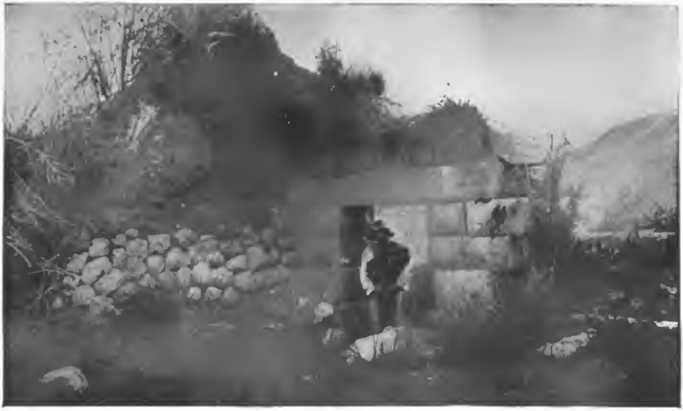


Photo by G. F. Eaton

ANOTHER VIEW OF MAUCALLACTA

The interior of the principal building at Pacaritampu. Notice the holes cut in the door-posts, to which a bar intended to close the door might be fastened

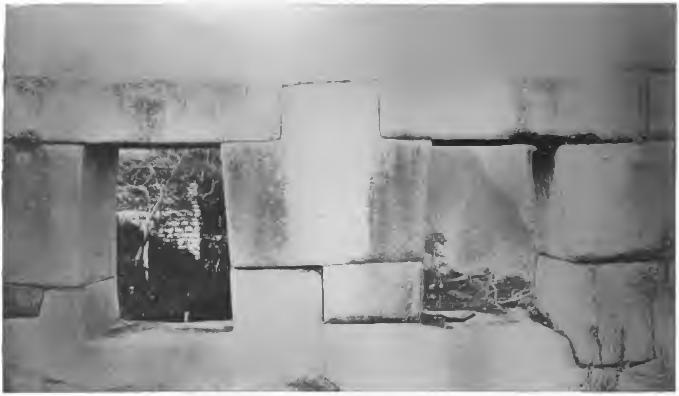


Photo by Hiram Bingham

WONDERFUL MASONRY AT MACHU PICCHU

Two of the windows in the remarkable three-windowed temple at Machu Picchu, which furnishes part of the convincing evidence that Machu Picchu and not Pacaritampu was the home of the ancestors of the Incas (see pages 409, 410, and 414).

The interest in this historical problem, connected with the fact that at Machu Picchu we had a wonderfully picturesque and remarkably large well-preserved city, untouched by Spanish hands, led us to feel that the entire place needed to be cleared of its jungle and carefully studied architecturally and topographically.

DIFFICULTIES OF THE APPROACH TO MACHU PICCHU

We decided to make a thorough hunt for places of burial and to collect as much osteological and ethnological material as could be found. Our task was not an easy one.

The engineers of the 1911 expedition—H. L. Tucker and P. B. Lanius—who had spent three weeks here making a preliminary map, had been unable to use the trail by which I had first visited Machu Picchu, and reported that the trail which they used was so bad as to make it impossible to carry heavy loads over it.

We knew that mule transportation was absolutely impracticable under these conditions, and that it was simply a question of making a foot-path over which Indian bearers could carry reasonably good-sized packs.

The first problem was the construction of a bridge over the Urubamba River to reach the foot of the easier of the two possible trails.

The little foot-bridge of four logs that I had used when visiting Machu Picchu for the first time, in July, 1911, was so badly treated by the early floods of the rainy season that when Mr. Tucker went to Machu Picchu at my request, two months later, to make the reconnaissance map, he found only one log left, and was obliged to use a difficult and more dangerous trail on the other side of the ridge.

Knowing that probably even this log had gone with the later floods, it was with some apprehension that I started Assistant Topographer Heald out from Cuzco early in July, 1912, with instructions to construct a bridge across the Urubamba River opposite Machu Picchu, and make a good trail from the river to the ruins—a trail sufficiently good for Indian bearers to use in carrying our 60-pound food-boxes up to the camp and, later, our 90-pound boxes of potsherds

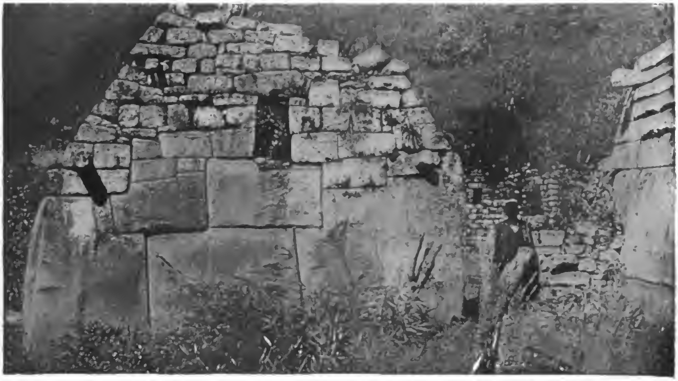


Photo by Hiram Bingham

PART OF THE SACRED PLAZA: MACHU PICCHU

One of the gable ends of the three-windowed temple. Notice the tremendous size of the granite blocks in the lower part of the wall. The small ventilating window, of which there is one in each end of the building, is not visible when the structure is looked at from below, and does not affect the striking character of the three large windows in the east wall of this building (see pages 408, 431, and 489).

and specimens down to the mule trail near the river.

SOME RAPID BRIDGE BUILDING

At the most feasible point for building a foot-bridge the Urubamba is some 80 feet wide. The roaring rapids are divided into four streams by large boulders in the river at this point. The first reach is 8 feet long, the next nearly 40 feet, the next about 22 feet, and the final one 15 feet.

For material in the construction of the bridge Mr. Heald had hardwood timber growing on the bank of the stream; for tools he had axes, machetes, and picks—all made in Hartford—and a coil of manila rope. For workmen he had 10 unwilling Indians, who had been forced to accompany him by the governor of the nearest town. For "guide, counsellor, and friend" he had an excellent Peruvian soldier, who could be counted on to see to it that the Indians kept faithfully at their task. In describing his work, Mr. Heald says:

"The first step was the felling of the timber for the first two reaches. That was quickly done and the short 8-foot space put in place. Then came the task of getting a stringer to the rock forming the next pier. My first scheme was to lay a log in the water, parallel to the bank and upstream from the bridge, and, fastening the lower end, to let the current swing the upper end around until it lodged on the central boulder. On trying this the timber proved to be so heavy that it sank and was lost.

"We next tried building out over the water as far as we could. Two heavy logs were put in place, with their butts on the shore and their outer ends projecting some 10 feet beyond the first span. The shore ends were weighted with rocks and cross-pieces were lashed on with lianas (sinewy vines), making the bridge about 4½ feet wide, as far as it went. Then a forked upright 10 feet high was lashed and wedged into place at the end of the first pier (see Fig. 1, page 422).

THE CROSSING ACHIEVED

"A long, light stringer was now pushed out on the completed part and the end

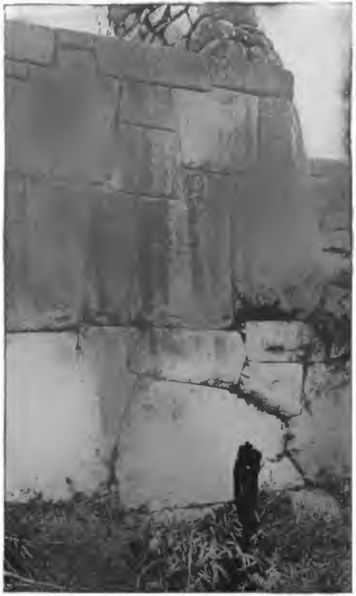


Photo by Hiram Bingham

THE TEMPLE OF THE THREE WINDOWS: MACHU PICCHU

An exterior view of part of the Temple of the Three Windows, showing the location of a former window which was filled up at some time in the past when it was considered suitable to reduce the number of windows in this remarkable structure from five to three. Tradition says that the Incas' ancestors came out of three caves, or windows. (See Markham's "Incas of Peru," Chapter IV.)

Photo by Hiram Bingham

THE WEST SIDE OF HUAYNA PICCHU: URUBAMBA CAÑON

One of the great precipices surrounding Machu Picchu and tending to make it an impregnable city of refuge. Notice also the extraordinary vigor of the vegetation which can find a footing on the face of a sheer granite precipice under favorable climatic conditions.

Photo by Hiram Bingham

A PICTURESQUE PART OF THE GRAND CAÑON OF THE URUBAMBA ON THE ROAD TO MACHU PICCHU, SOUTHERN PERU (SEE PAGE 403)

Photo by Hiram Bingham

A GOOD MULE ROAD IN SOUTHERN PERU

A view of the road in the bottom of the cañon near Machu Picchu (see page 403)

Photo by Hiram Bingham

THE ROAD IN THE URUBAMBA CAÑON NEAR MACHU PICCHU

If it had not been for this new government road cut at great expense in the face of the precipices of the Urubamba Cañon, it would not have been possible for us to have reached the vicinity of Machu Picchu with our mules and supplies. This ancient city is in the heart of a region most wonderfully defended by nature; the most inaccessible part of the Andes (see page 403)

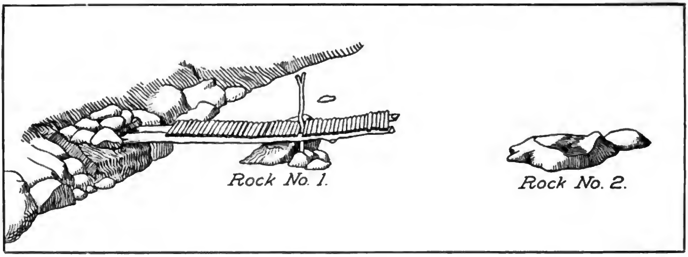

Rock No. 1.
Rock No. 2.

FIGURE 1. THE FIRST STAGE IN MAKING THE BRIDGE BY WHICH WE CROSSED THE URUBAMBA RIVER TO REACH THE FOOT OF THE PRECIPICE NEAR MACHU PICCHU

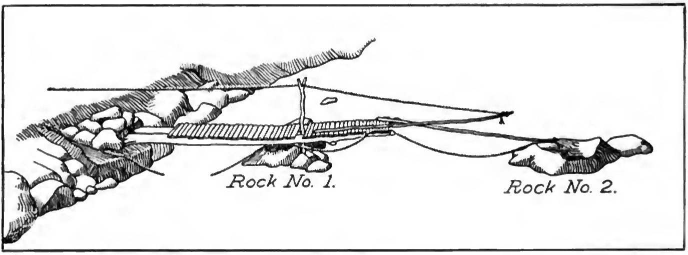

Rock No. 1.
Rock No. 2.

FIGURE 2. "A LONG STRINGER WAS NOW PUSHED OUT ON THE COMPLETED PART AND THE END THRUST OUT OVER THE WATER"

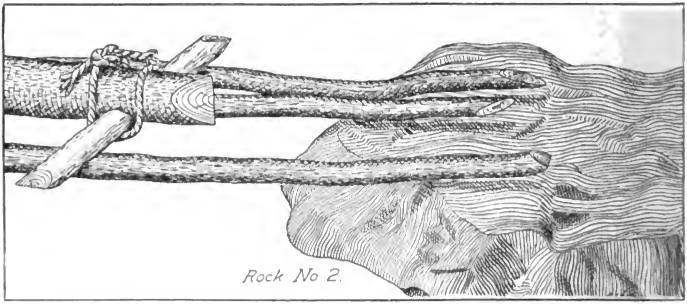


FIGURE 3. THE FINAL STAGE IN GETTING THE HEAVY TIMBER ACROSS THE RAPIDS (SEE PAGES 417 AND 423)

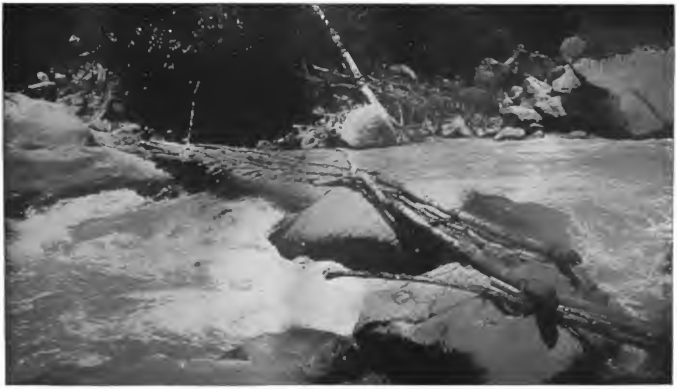


Photo by Hiram Bingham

HEALD'S BRIDGE: MACHU PICCHU

The completed bridge over the rapids of the Urubamba, showing the forked upright still in place. The great difficulty in building this bridge lay in the fact that the timber was of such density that it would not float.

thrust out over the water toward rock No. 2, the end being held up by a rope fastened around it and passing through the fork of the upright (see Fig. 2, page 422).

"This method proved successful, the timber's end being laid on the rock which formed our second pier. Two more light timbers were put across this way, and then a heavy one was tried, part of its weight being borne by the pieces already across by means of a yoke locked in the end (see Fig. 3). This and another piece were successfully passed over, and after that there was little trouble, cross-pieces being used to form the next and shorter span. . . .

"On the second day of work we finished the bridge about noon and started making a trail up the hill under the guidance of a half-breed who lived in the vicinity. After the first quarter mile the going was very slow. Not only did the steepness of the slope and the tangled condition of the cane jungle retard us, but the men were very much afraid of snakes, a fear which proved itself justified, for one of them was very nearly bitten by a little gray snake about 12 inches long.

"The second day's work on the

Photo by Hiram Bingham

THE EXPEDITION EN ROUTE TO MACHU PICCHU: URUBAMBA CAÑON

A newly repaired part of the government road and a portion of our caravan en route to Machu Picchu.

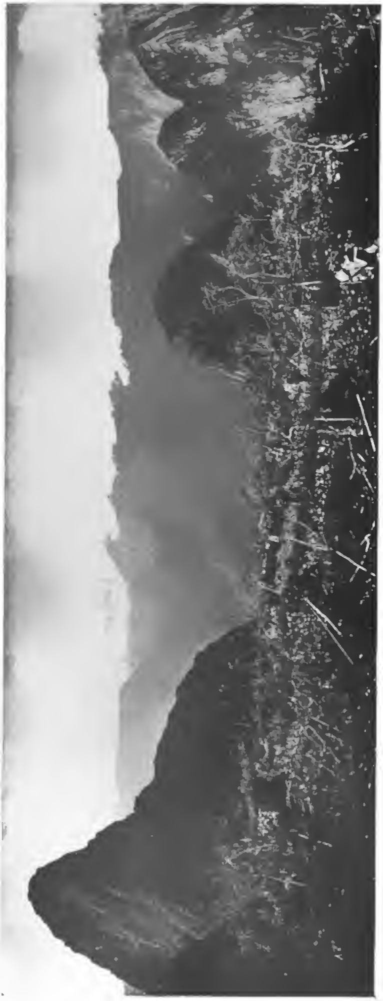


Photo by Hiram Bingham

MACHU PICCHU AND THE WONDERFUL URUBAMBA CAÑON

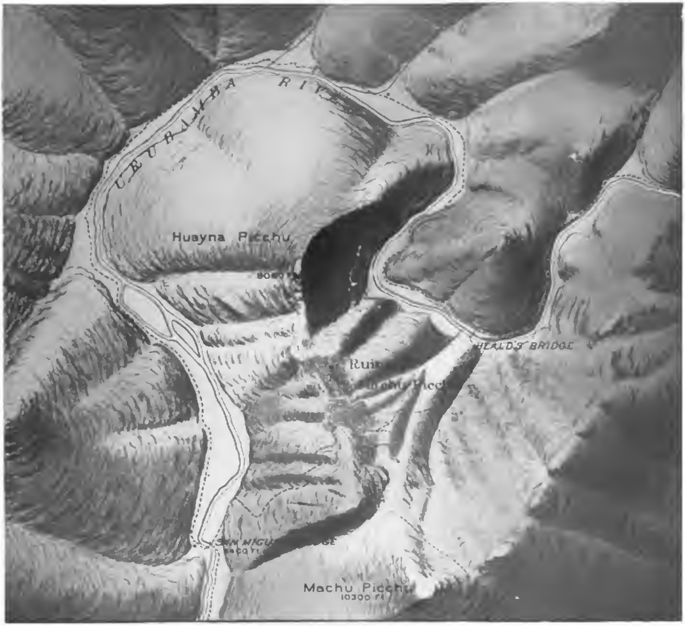
A general view of the east side of Machu Picchu before the clearing of 1912. One of the most serious difficulties in clearing the ruins was the disposal of the great hardwood trees without destroying the walls of the houses. Huayna Picchu, the ascent of which nearly cost the life of Assistant Topographer Heald, is the peak on the extreme left (see pages 427, 431, and 438). Compare with pictures, pages 508 and 511.

trail took us to the city. The path was still far from being finished, though. There were many places which were almost vertical, in which we had to cut steps. Up these places we now made zigzags, so that there was comparatively little difficulty in climbing.

"On the first day I had set fire to the cane in order to clear the trail. This fire did not clear much, however. On the second day I was about a quarter of a mile behind the workmen, or rather above them, when suddenly Tomás (the Peruvian soldier mentioned above), who was with me, said: 'Look, they have fired the cane.' Sure enough, they had started it, and in a minute it had gained headway and was roaring up toward us, the flames reaching 15 or 20 feet into the air.

ESCAPE FROM FIRE IN THE JUNGLE

"There was nothing for us but to run, and we did that, tearing through the jungle down hill in an effort to get around the side of the fire. Suddenly, on one of my jumps, I didn't stop when I expected to, but kept right on through the air. The brush had masked a nice little 8-foot jump-off, and I got beautifully bumped. In a minute there came a thump, and Tomás landed be-



Surveyed by Robert Stephenson
Drawn by Albert H. Bumstead

MAP OF MACHU PICCHU AND VICINITY

This relief map of Machu Picchu and vicinity gives a good general idea of the relative position of Heald's bridge, the ruins, and the two peaks—Machu Picchu and Huayna Picchu. It also shows the location of the two trails up from the Urubamba River and enables one to form some conception of the extent of the ruins. The map is misleading in that the precipices are flattened out as they would be if one were looking down upon them from a balloon.

side me. It amused me so much to watch him that I forgot all about my own jolted bones. There was nothing broken, however, and we made our way without much more trouble around the fire and fell upon the peons, who were gathered in a bunch, speculating as to where we might be."

Three days later I reached Machu Picchu in company with Dr. Eaton, our osteologist, and Mr. Erdis, who, as archeological engineer, was to have charge of the general work of clearing and excavating the ruins.

Mr. Heald was at once relieved from further duty at Machu Picchu, where he had just begun the work of clearing, and was asked to see whether he could get to the top of the neighboring peak, called "Huayna Picchu," and investigate the story that there were magnificent ruins upon its summit. The same Indian who had originally told me about the ruins at Machu Picchu had repeatedly declared

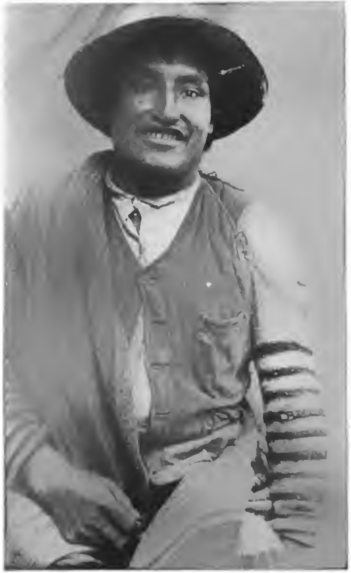


Photo by Hiram Bingham

A CHEERFUL WORKMAN FROM CUZCO

Portrait of Alegria, "Mr. Happiness," one of our workmen, who came with us from Cuzco and staid for nearly two months. Most of the workmen were content with what wages they could earn in two weeks, and kept us continually busy trying to replace them.

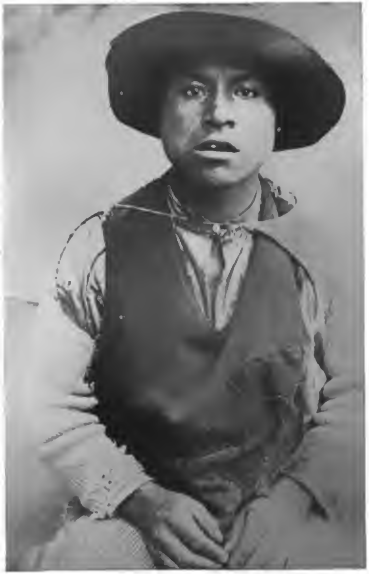


Photo by Hiram Bingham

THE BEST TYPE OF INDIAN WORKMAN: SOUTHERN PERU

Portrait of Enrique Porres, one of the most intelligent workmen that we had to assist in excavating Machu Picchu. In his cheek may be observed a swelling, showing the presence of a quid of coca, the leaves of the plant from which cocaine is extracted. Nearly all the Mountain Indians chew the coca leaf. A quid is carefully made up at the beginning of the day's work, during the middle of the morning, at the commencement of the afternoon's work, and in the middle of the afternoon.

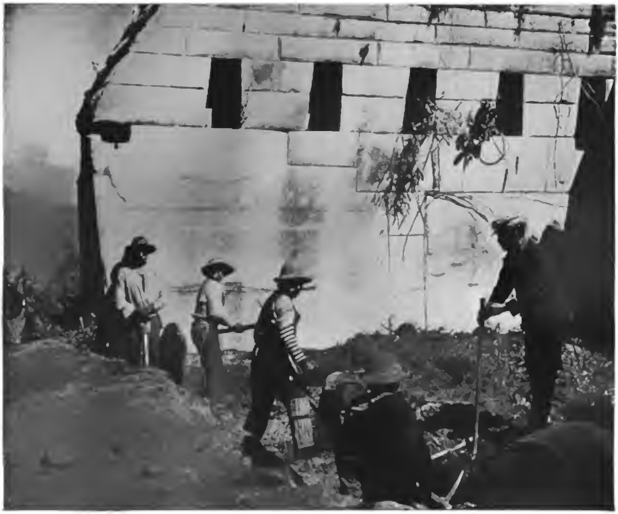


Photo by Hiram Bingham

EXCAVATING AT MACHU PICCHU

Commencing the work of excavating in the Chief Temple at Machu Picchu. Lieutenant Sotomayor, at the right, in charge of the gang of Indians

that those on Huayna Picchu were only slightly inferior. Mr. Heald's report of his work on Huayna Picchu runs in part as follows:

"Huayna Picchu, lying to the north of Machu Picchu, and connected with it by a narrow neck, rises some 2,500 feet above the Urubamba River, which runs around its base. On one side, the south, this elevation is reached by what is practically one complete precipice. On the other, while there are sheer ascents, there are also slopes, and, according to the account of one Arteaga, who claims to have explored the forests which cover a good deal of it, was once cultivated, the slopes being converted into level fields by low earth terraces (see page 424).

ATTEMPT AT SCALING HUAYNA PICCHU

"This mountain is, like Machu Picchu, cut from medium-grained gray to red granite, which accounts in part for its sharp, craggy outlines. The lower slopes, where there are any, are covered with forest growths of large trees. A peculiar thing in this connection is one solitary palm tree, which rises above the other vegetation. Near the top the large trees give place to cane and mesquite, while many slopes have nothing but grass. This last is due more to steepness and lack of soil than to any peculiarity of elevation or location, however. . . .

"My first trip to reach the summit of Huayna Picchu and to ascertain what ruins, if any, were on it, ended in failure. The only man who had been up (Arteaga), who lives at Mandor Pampa, was drunk, and refused to go with me; so I decided to try to find a way without his help. I knew where his bridge crossed the Urubamba River and where he had started up when he went the year before. With these two things to help me, I thought that I could very likely find as

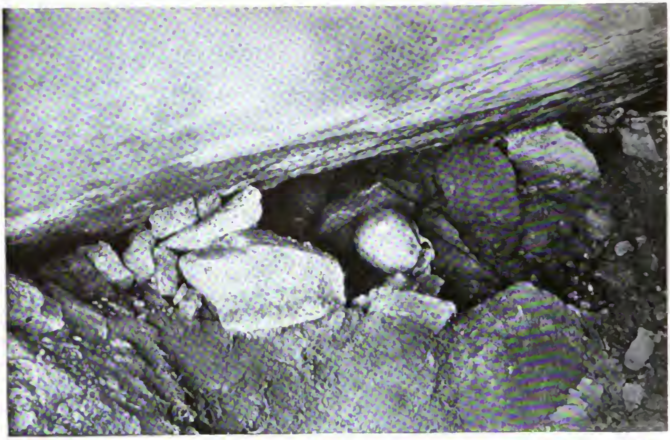


Photo by Hiram Bingham

A BURIAL CAVE AT MACHU PICCHU

The first burial cave discovered at Machu Picchu containing a human skull. The picture was taken after partial excavation, showing the skull still in place. In all, more than 100 such caves were opened and a large quantity of skeletal material secured.

Photo by Hiram Bingham

THE SAME CAVE FROM A DISTANCE OF 20 FEET: MACHU PICCHU

It was extremely difficult to find these caves. Here is a picture of cave No. 1 from a distance of only 20 feet. The entrance to the cave is near the center of the picture. It may be imagined that not the least portion of our difficulties was the cutting of paths through this dense tropical jungle and the transportation of material from the caves in which it was found. This cave was on the side of the mountain about 800 feet below the city of Machu Picchu (see pages 446 and 447).

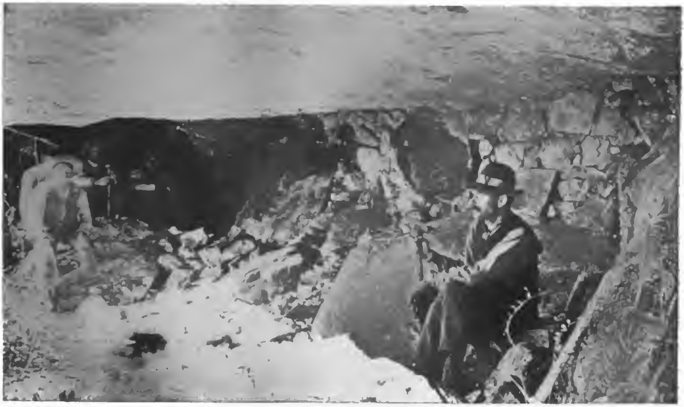


Photo by Hiram Bingham

A LARGE BURIAL CAVE: MACHU PICCHU

A flashlight view of cave No. 9, one of the larger burial caves, in the floor of which a number of skeletons were found. On the ground among the rocks were pieces of beautiful large pots, which may have been destroyed at the time of burial (see pages 446-447).

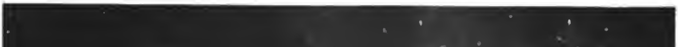


Photo by Hiram Bingham

COLLECTING THE SKELETAL REMAINS OF THE ANCIENT INHABITANTS: MACHU PICCHU

A flashlight view of the interior of cave No. 11, showing the osteologist, Dr. Eaton, and his Indian helpers during the excavation of a human skeleton. The man at the right is a soldier kindly loaned to us by the Peruvian government to assist us in securing laborers.

Photo by Hiram Bingham

THE LARGEST CAVE AT MACHU PICCHU

A flashlight view of the interior of the largest cave, at the base of one of the great precipices of Huayna Picchu. The cave is nearly 90 feet in length and is partly lined with cut stones. It had long been known to the Indian treasure-hunters of the neighborhood, and consequently yielded no results (see pages 446-447).

Photo by Hiram Bingham

THE CENTER OF THE BEST COLLECTING DISTRICT: MACHU PICCHU

Archeological Engineer Erdis standing near one of the boulders within the city of Machu Picchu, in the vicinity of which he made the discovery that articles of bronze were likely to be found 2 or 3 feet underground (see page 449).

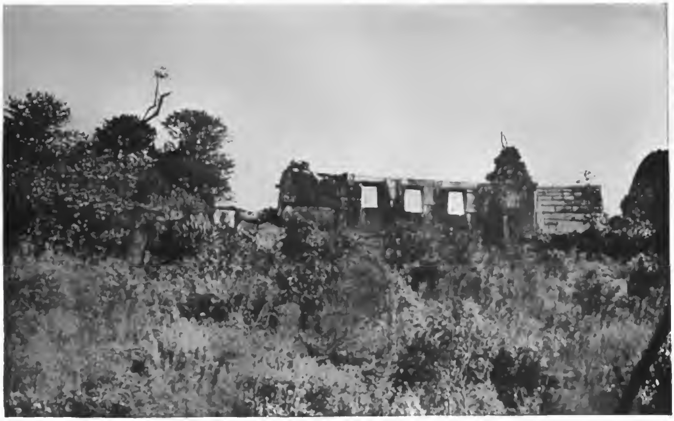


Photo by Hiram Bingham

THE TEMPLE OF THE THREE WINDOWS: MACHU PICCHU

The floors of the principal temples yielded little, but on the terraces beneath the walls of the three-windowed temple, here shown, we found potsherds and artifacts to a depth of four or five feet (see pages 440 and 449).

much as he had. Accordingly, I started with four peons and Tomás Cobines, the soldier, to have a look.

"The river was passed easily on the rather shaky four-pole bridge, and we started up the slope, cutting steps as we went, for it was almost vertical. About 30 feet up it moderated, however, and, after that, while it was steep, we seldom had to cut steps for more than 20 to 30 feet on a stretch. The greatest hindrance was the cane and long grass, through which it was hard to cut a way with the machetes.

"Our progress, slow at first, got absolutely snail-like as the men got tired; so, getting impatient, I resolved to push on alone, telling them to follow the marks of my machete, and charging Tomás to see that they made a good trail and did not loaf.

"I pushed on up the hill, clearing my way with the machete, or down on all fours, following a bear trail (of which there were many), stopping occasionally to open my shirt at the throat and cool off, as it was terribly hot. The brush through which I made my way was in great part mesquite, terribly tough and with heavy, strong thorns. If a branch was not cut through at one blow, it was pretty sure to come whipping back and drive half a dozen spikes into hands, arms, and body. Luckily I had had enough practice to learn how to strike with a heavy shoulder blow, and for the most part made clean strokes, but I didn't get away untouched by any means.

A NARROW ESCAPE

"Finally, about 3 p. m., I had almost gained the top of the lowest part of the ridge, which runs along like the back-plates of some spined dinosaur. The trees had given way to grass or bare rock, the face of the rock being practically vertical. A cliff some 200 feet high stood in my way. By going out to the end of the ridge I thought I could look almost straight down to the river, which looked more like a trout-brook than a river at that distance, though its roar in the rapids came up distinctly.

"I was just climbing out on the top of the lowest 'back-plate' when the grass and soil under my feet let go, and I

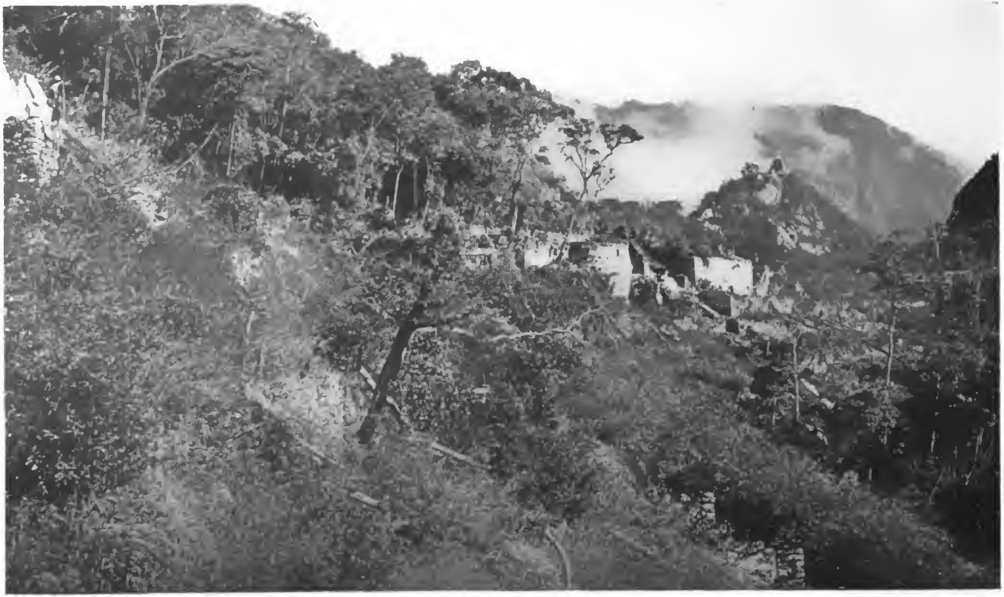


Photo by Hiram Bingham

MACHU PICCHU AFTER TEN DAYS' CLEARING

General view of the west side of Machu Picchu, showing our camp in the upper left-hand corner and a portion of the city after ten days of clearing. Under the old tropical forest was one of the most important portions of the city. The effect of clearing this forest is shown in the next picture.

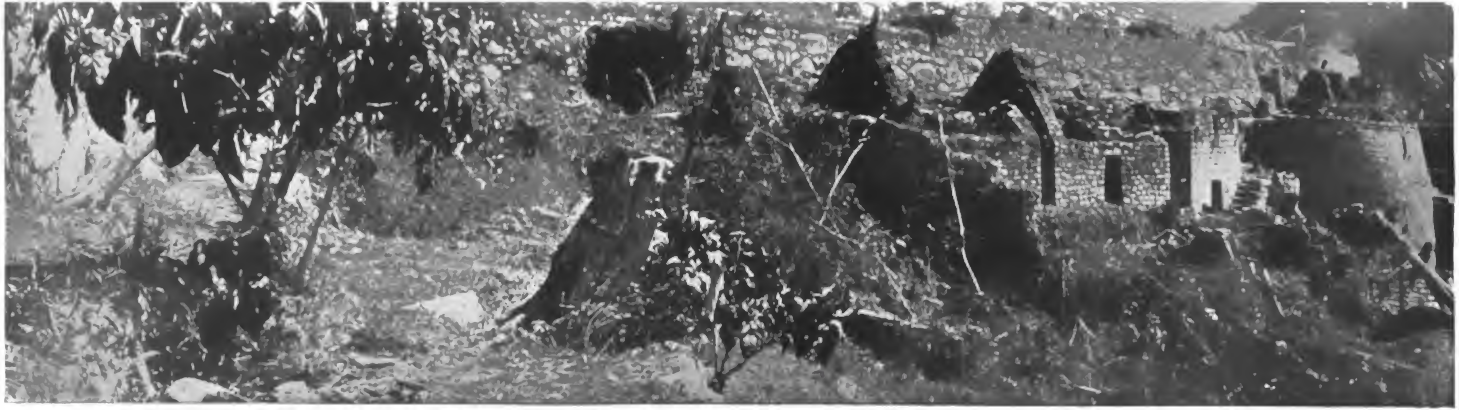
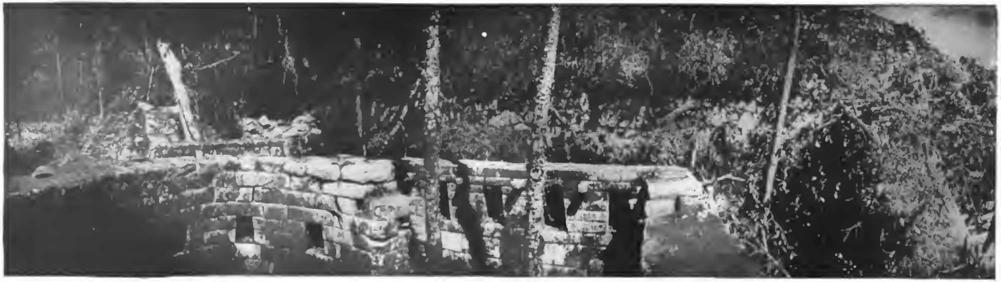


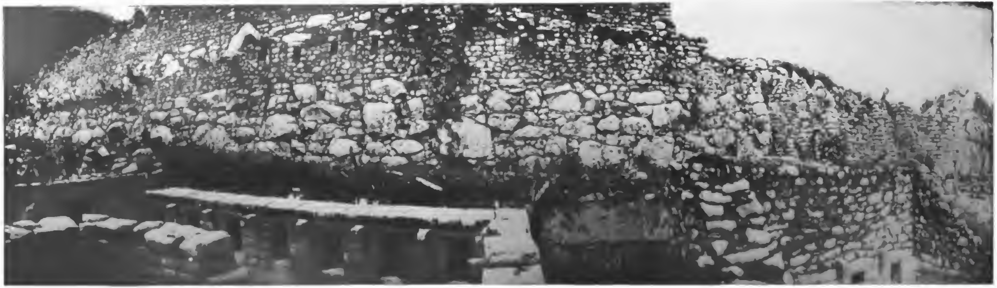
Photo by Hiram Bingham

MACHU PICCHU A MONTH LATER

A nearer view of the same place one month later, showing the terraces of the upper city and the rows of windowed houses that had been hidden for centuries beneath the tropical forest (see page 449)



A VIEW OF ONE OF THE MOST INTERESTING PARTS OF MACHU PICCHU AFTER THE PRELIMINARY CLEARING



Photos by Hiram Bingham

THE SAME THREE MONTHS LATER

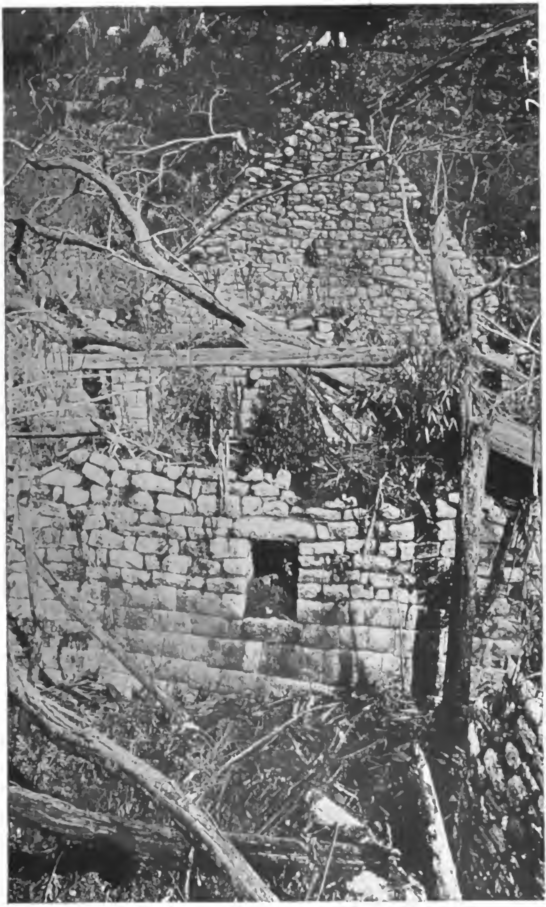


Photo by Hiram Bingham

A STAGE IN THE CLEARING OF MACHU PICCHU

Our first camp is just visible at the top of the picture. The buildings in the foreground belong to what was called the Ingenuity Group. The picture was taken during the preliminary clearing.

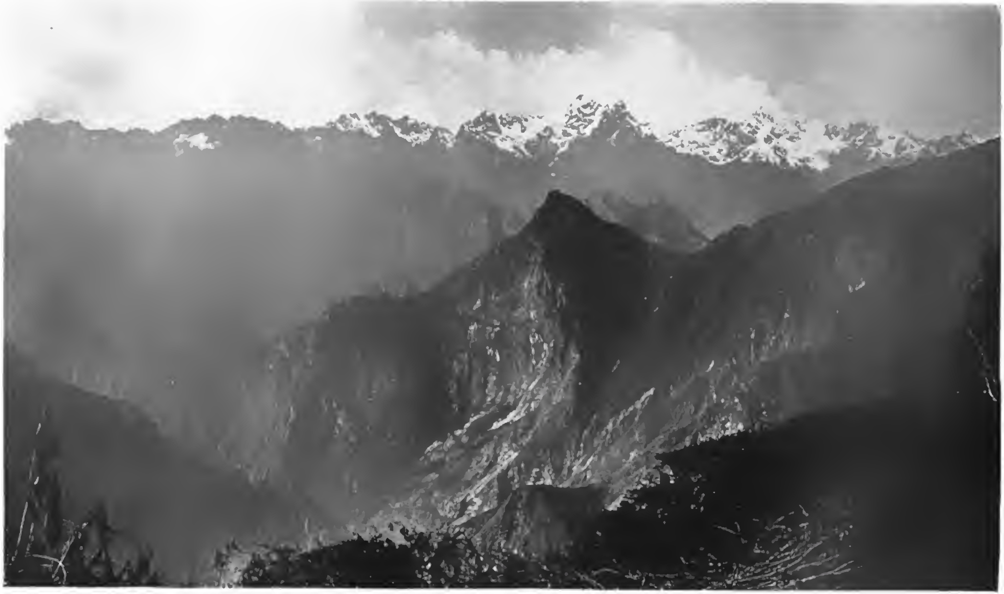


Photo by Hiram Bingham

THE NARROW RIDGE ON WHICH MACHU PICCHU IS SITUATED AND THE MAGNIFICENT URUBAMBA CAÑON

A distant view of Machu Picchu on its narrow ridge, flanked by precipices, in the most inaccessible corner of the Andes in the heart of the Urubamba Cañon. The sharp peak in the right foreground is Machu Picchu Mountain. The lower conical peak at the extreme left is Huayna Picchu. The city of Machu Picchu is on top of the ridge between these two peaks and almost directly underneath the little fleecy cloud which hides part of a distant mountain (see page 453)

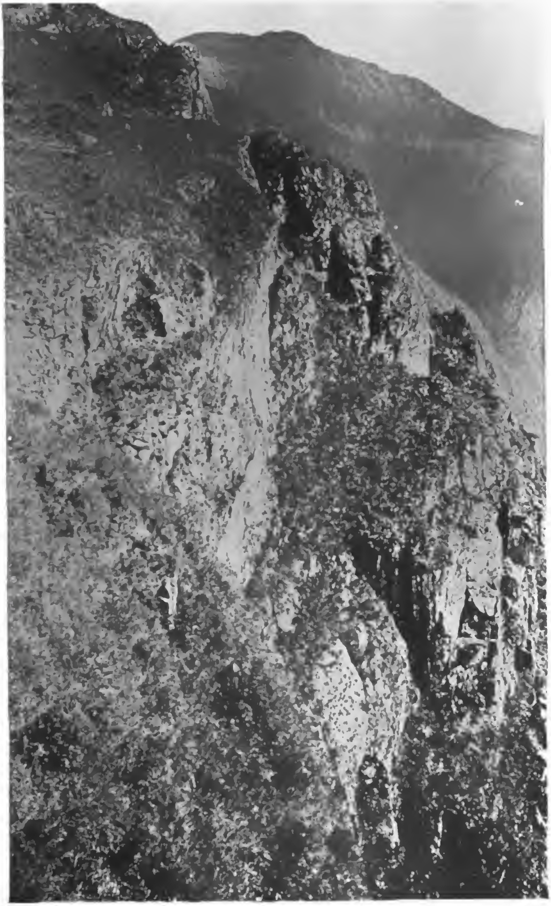


Photo by Hiram Bingham

ONE OF THE MAGNIFICENT PRECIPICES WHICH MADE THE CITY OF MACHU PICCHU INVULNERABLE (SEE PAGE 453) dropped. For about 20 feet there was a slope of about 70 degrees, and then a jump of about 200 feet, after which it would be bump and repeat down to the river.

"As I shot down the sloping surface I reached out and with my right hand grasped a mesquite bush that was growing in a crack about 5 feet above the jump-off. I was going so fast that it jerked my arm up, and, as my body was turning, pulled me from my side to my face; also, the jerk broke the ligaments holding the outer ends of the clavicle and scapula together. The strength left the arm with the tearing loose of the ligaments, but I had checked enough to give me a chance to get hold of a branch with my left hand.

"After hanging for a moment or two, so as to look everything over, and be sure that I did nothing wrong, I started to work back up. The hardest part was to get my feet on the trunk of the little tree to which I was holding on. The fact that I was wearing moccasins instead of boots helped a great deal here, as they would take hold of the rock. It was distressingly slow work, but after about half an hour I had gotten back to comparatively safe footing. As my right arm was almost useless, I at once made my way down, getting back to camp about 5.30, taking the workmen with me as I went.

"On this trip I saw no sign of Inca work, except one small ruined wall. . . ."

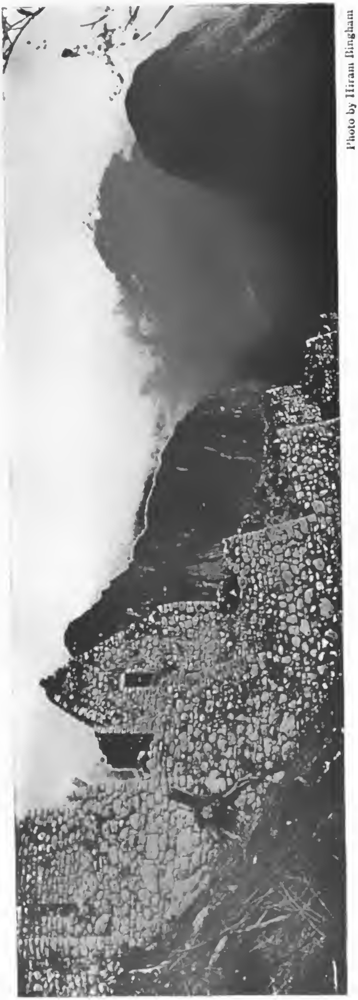


Photo by Hiram Bingham

THE OUTER CITY WALL: MACHU PICCHU

The defenses of Machu Picchu consisted of two walls and a dry moat running across the ridge from precipice to precipice. In this picture may be seen the outer wall and the ruins of buildings probably used by the soldiers who protected the outer defenses (see page 453)

SUCCESS AT THE THIRD ATTEMPT

Five days later Mr. Heald judged that his arm was in sufficiently good shape so that he could continue the work, and he very pluckily made

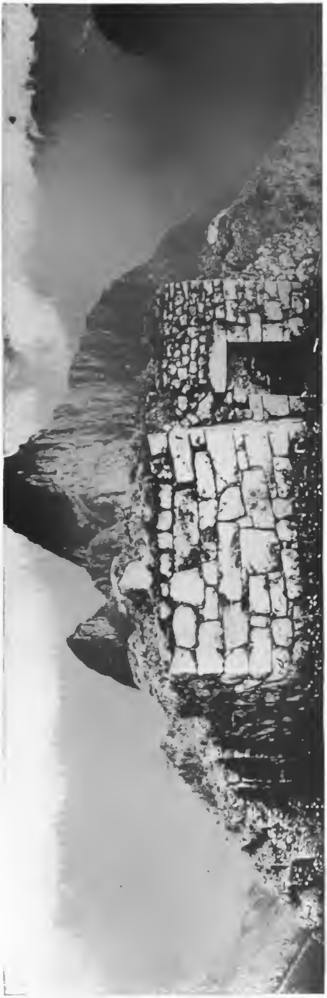


Photo by Hiram Bingham

THE INNER WALL AND THE CITY GATE: MACHU PICCHU (SEE PAGE 453)

By building this wall forward from the gate, it was possible to direct a lateral fire on besiegers. Ammunition consisted of stones—large ones which could be thrown down on the heads of an attacking force, and small cobble stones brought up from the river 2,000 feet below to be used in slings. Piles of this selected ammunition were found in various parts of the defenses.

another attempt to reach the top of Huayna Picchu. This likewise ended in failure; but on the following day he returned to the attack, followed his old trail up some 1,700 feet, and, guided by the same half-breed who had told us about the ruins, eventually reached the top. His men were obliged to cut steps in the steep slope for a part of the distance, until they came to some of stone stairs, which led them practically to the summit.

The top consisted of a jumbled mass of granite boulders about 2,500 feet above the river. There were no houses, though there were several flights of steps and three little caves. No family could have wished to live there. It might have been a signal station.

After Mr. Heald had left Machu Picchu we set ourselves to work to see whether excavation in the principal structures would lead to discovery of any sherds or artifacts. It did not take us long to discover that there were potsherds outside of and beneath the outer walls of several of the important structures, but our digging inside the walls of the principal temples was almost without any results whatsoever. We did find that the floor of the principal temple had been carefully made of a mixture of granite gravel, sand, and clay, laid on top of small stones, and these again on top of a mass of granite rocks and boulders. When the temple was in use this clean, white floor must have been an attractive feature.

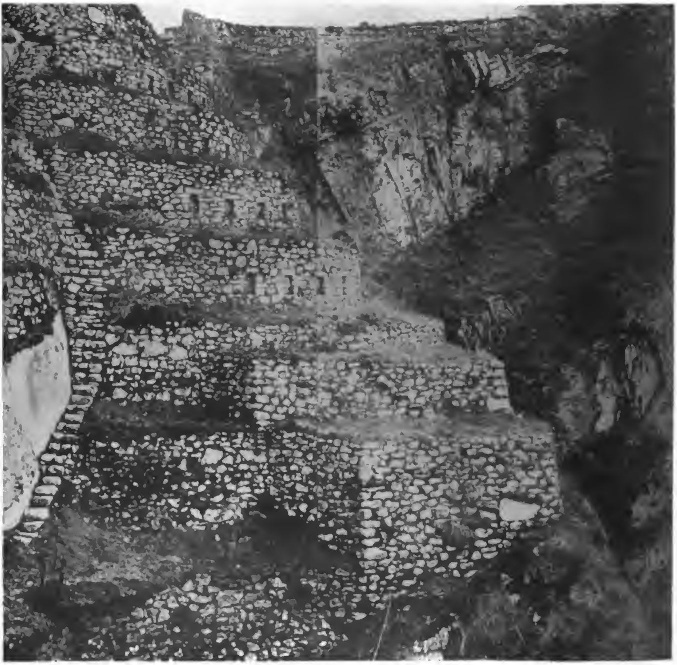


Photo by Hiram Bingham

THE WESTERN TERRACES AND THE STEEP WINDING STAIRWAY: MACHU PICCHU

It was difficult to feed the thousands of people who at one time may have occupied Machu Picchu, and every square foot of available land was terraced off to provide a place for the crops of Indian corn and potatoes, which were their chief resource. These terraces were all connected by stairways, sometimes steep, narrow, and winding like the one on the left, at other times consisting of a row of projecting stones in the face of the terrace, as is the case in the second terrace below the lowest line of niches in this picture (pages 454-459).

THE FIRST EXCAVATIONS

Our workmen excavated with a will, for the tests made with a crowbar gave such resounding hollow sounds that they felt sure there was treasure to be found beneath the floor of the ancient temple. In places the excavation was carried to a depth of 8 or 9 feet, and practically the entire floor of the temple was excavated to a depth of 3 or 4 feet; but all this back-breaking work ended only in disappointment. There were many crevices and holes between the boulders under the floor, but nothing in them—not even a bone or potsherd.

Digging in the temple of the Three Windows had a similar negative result, but digging outside on the terrace below the three windows resulted in a large quantity of decorated potsherds. Most

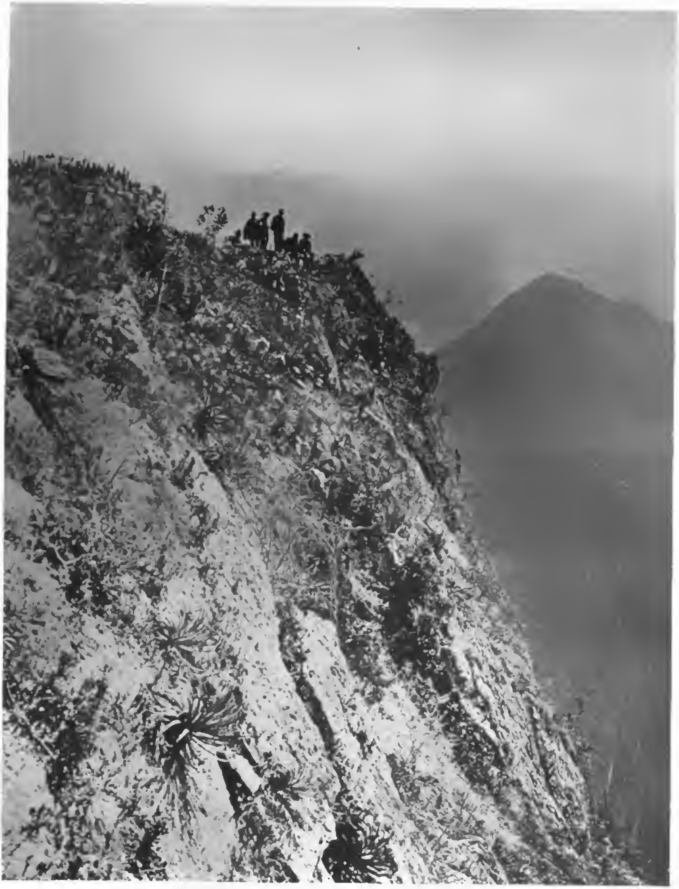


Photo by Hiram Bingham

AN ANCIENT SIGNAL STATION ON MACHU PICCHU MOUNTAIN

On the very summit of one of the most stupendous precipices the Incas constructed a signal station from which the approach of an enemy could be instantly communicated to the city below. By looking very carefully the terraced walls of this signal station may be seen just below the figures who are standing on an artificial platform (see pages 442 and 453).

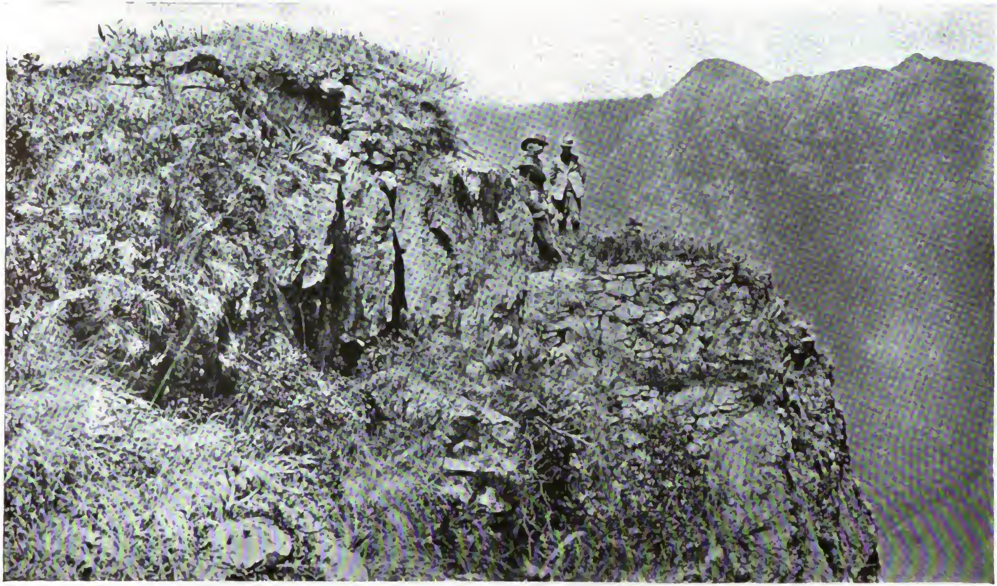


Photo by Hiram Bingham

A NEARER VIEW OF THE PLATFORM SKILFULLY CONSTRUCTED ON TOP OF MACHU PICCHU MOUNTAIN 4,000 FEET ABOVE THE RIVER IN THE VALLEY BELOW (SEE PAGES 441 AND 453)

Photo by Hiram Bingham

THE TOP OF MACHU PICCHU MOUNTAIN

Another portion of the mountain-top, showing a skilfully laid retaining wall on the very top of a precipice overhanging the cañon. If any of the workmen who built that wall slipped, he must have fallen a thousand feet before striking any portion of the cliff.

Photo by Hiram Bingham

THE DRY MOAT OF THE DEFENSES OF MACHU PICCHU

Just outside the inner walls of Machu Picchu the builders constructed a dry moat which ran directly across the hill. In this picture of the moat the city walls may be seen above on the right and the agricultural terraces on the left (see page 453).

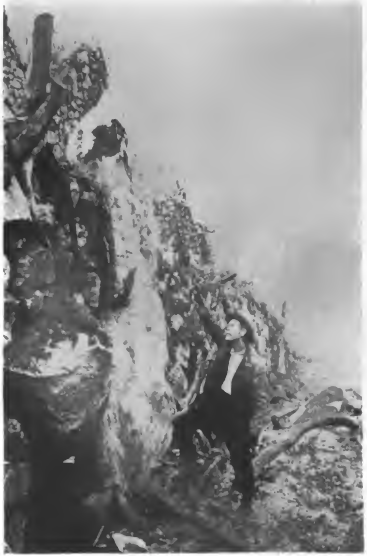


Photo by Hiram Bingham

A HUGE ROCK IN THE DEFENSES OF MACHU PICCHU

The moat is still from 6 to 8 feet deep, but has probably been partly filled up by the accumulations of centuries. In places unusually large rocks were used in the construction of the inner wall of the moat (see pages 446 and 453).

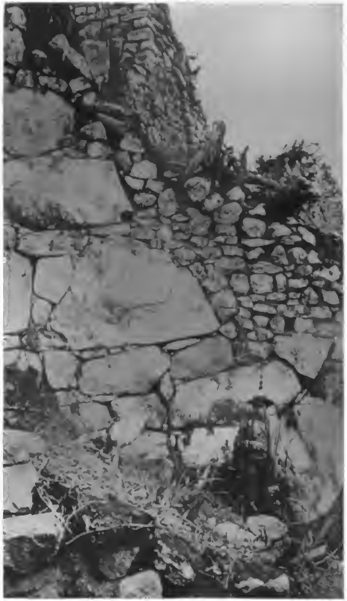


Photo by Hiram Bingham

THE DEFENSES OF MACHU PICCHU: THE INNER WALL

Besides the moat, the inner defenses of Machu Picchu consisted of a high wall strongly built of large, rough boulders. The Incas were good engineers and thoroughly understood the art of drainage. In this picture of the wall may be seen two outlets for water, permitting the terraces within the wall to be properly drained.

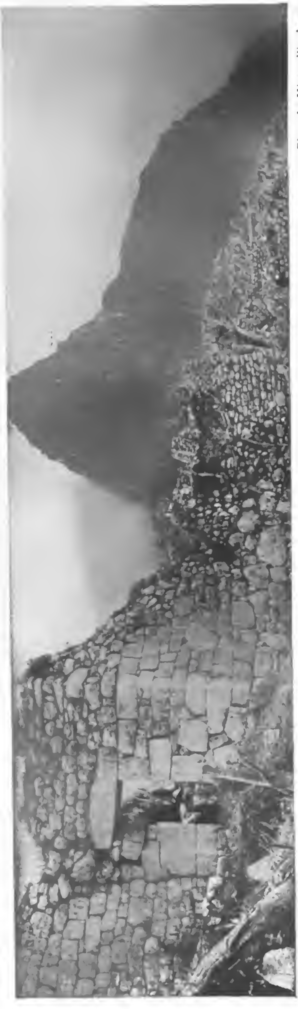


Photo by Hiram Bingham

THE DEFENSES OF MACHU PICCHU: THE INNER WALL AND THE CITY GATE

The main city gate of Machu Picchu was on the very summit of the ridge. Its defense was made easy by bringing the wall out in a salient angle on the left of the gate, so that a perfect shower of stones could be rained on the heads of besiegers. The peak in the distance is Huayna Picchu (see page 453).

of them were 2 to 4 feet under the surface. It seemed as though it had been the custom for a long period of time to throw earthenware out of the windows of this edifice.

At the end of a week of hard and continuous labor we had not succeeded in finding a single skull, a single burial cave, nor any pieces of bronze or pots worth mentioning. We did not like to resort to the giving of prizes at such an early stage. A day or two spent in hunting over the mountain side with the Indians for burial caves yielding no results, we finally offered a prize of one sol (50 cents gold) to any workman who would report the whereabouts of a cave containing a skull, and who would leave the cave exactly as he found it, allowing us to see the skull actually in position.

THE SEARCH FOR BURIAL CAVES

The next day all the workmen were allowed to follow their own devices, and they started out early on a feverish hunt for burial caves. The half dozen worthies whom we had brought with us from Cuzco returned at the end of the day tattered and torn, sadder and no wiser. They had hewed their way through the jungle, one of them had cut open his big toe with his machete, their clothes were in shreds, and they had found nothing.

But the Indians who lived in the vicinity, and who had undoubtedly engaged in treasure-hunting before, responded nobly to the offer of a prize, and came back at the end of the day with the story that they had discovered not one, but eight, burial caves, and desired eight soles.

This was the beginning of a highly successful effort to locate and collect the skeletal remains of the ancient inhabitants of Machu Picchu. Fifty-two graves in and near this ancient city were excavated by Dr. Eaton, our osteologist, and fully as many more were

Photo by Hiram Bingham

ANOTHER VIEW OF THE CITY GATE: MACHU PICCHU

Looking outward from within the city, and showing the graded approach that runs across the agricultural terraces

afterward located and explored under the supervision of Mr. Erdis, the archeological engineer. The greatest number of these graves were in caves under the large boulders and projecting ledges of the mountain side, and the method usually followed by the osteologist in exploring them was, first, to photograph the entrance of the cave from without, after which the grave was opened and its contents carefully removed. Measurements were taken and diagrams were made to show the position of the human skeletons and the arrangement of the accompanying pottery, implements, ornaments, and bones of lower animals.

In a few instances it was possible also to photograph the interiors of graves.

CONTENTS OF THE BURIAL CAVES

In some of the caves only the most fragmentary skeletal remains were found; in others only the larger bones and a skull or two; while others contained not only nearly complete skeletons, but pots in more or less perfect state of preservation, and occasionally pieces of bronze. In this way a large and valuable collection was made of human skeletons, pottery, and other artifacts of various materials, including some of the tools probably used by the Inca or pre-Inca stone-masons in the more intricate parts of their work.

Before dismissing the subject of the ancient graves, it may be noted that the custom seems to have been, whenever possible, to bury the dead in the sitting position, with the knees raised. In a very few instances bodies were interred in crudely fashioned "bottle-shaped graves." While engaged in this work the collec-

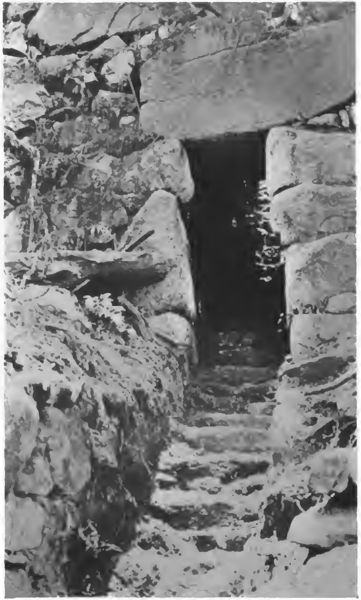


Photo by Hiram Bingham

A TUNNEL UNDER THE MAIN ROAD: MACHU PICCHU

The road from the outer world to the city of Machu Picchu was a well-made footpath about 4 feet wide. It crosses the agricultural terraces. In the place shown in the picture, the workmen had constructed a tunnel underneath this road, so as to pass more quickly from the upper to the lower terraces.

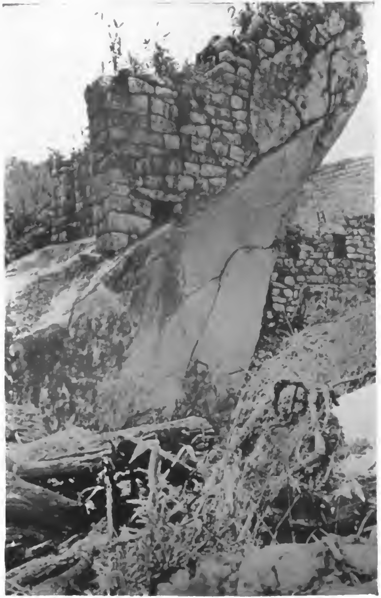


Photo by Hiram Bingham

THE HOUSE BUILT ON A ROCK: MACHU PICCHU

An example of the ingenuity of this ancient race of stone cutters who were able, without the use of mortar or cement, to build their houses on rocks even when the rocks were lying at an angle of nearly 40 degrees.

Photo by Hiram Bingham.

THE MAIN ROAD TO MACHU PICCHU

A nearer view of the graded approach to Machu Picchu; part of the principal road which connected the city with the outer world

tors were greatly annoyed by the venomous serpents of the region, and several of these serpents were killed and preserved in alcohol.

The burial caves occur generally on the sides of the mountain below the ruins. As they are in well nigh inaccessible locations and more or less covered with dense tropical jungle, the work of visiting and excavating them was extremely arduous, and it is most highly to the credit of those engaged in it that so many caves were opened and so much material gathered. Practically every square rod of the sides of the ridge was explored. The last caves that were opened were very near the Urubamba River itself, where the ancient laborers may have had their huts.

It is too early as yet to give any generalizations with regard to the anatomical characteristics of the Machu Picchu people as evidenced by their skeletal remains. A few of the skulls show decided marks of artificial deformation, but most of them are normal.

Mr. Erdis eventually made the discovery that by digging at least 18 inches underground, at the mouths of small caves, under large boulders, within 200 yards of the Three Window Temple, he was almost sure to find one or two articles of bronze, either pins, tweezers, pendants, or other ornaments.

Selecting two of the most reliable workmen and offering them a sliding scale of rewards for everything they might find of value, he succeeded, in the course of four months' faithful attention to the details of clearing and excavating, in getting together about 200 little bronzes, a lesser number of pots, and 50 cases of sherds. The nature of the more interesting finds can be better understood by the accompanying photograph (see page 573). This material is now all in New Haven, where it is to be arranged by Dr. Eaton and Mr. Erdis.

WHAT CLEARING THE JUNGLE REVEALED

The change made in the appearance of Machu Picchu by the four months of clearing and excavating is graphically brought out by comparing the pictures on pages 404, 424, 432, and 499 with those on pages 433, 434, 490, 498, and 512, the one set taken either before the work began or early in its stages and the latter taken at the end of the season. It

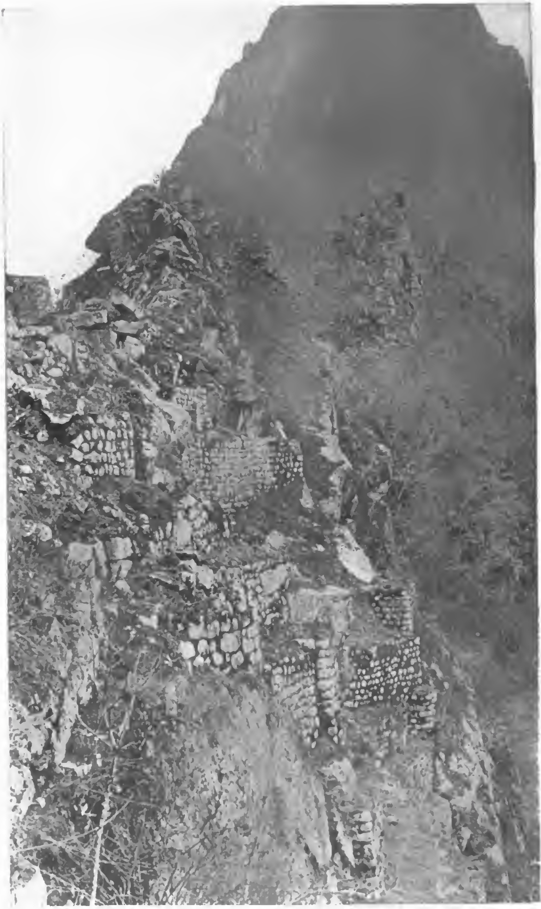


Photo by Hiram Bingham

THE DEFENSES OF THE CITY: THE NORTHERN TERRACES, MACHU PICCHU

On the north side of the city there was little danger of attack, but in order to strengthen the nearly impassible cliffs and precipices, narrow terraces that could be used both for agricultural and defensive purposes were constructed (see page 453).

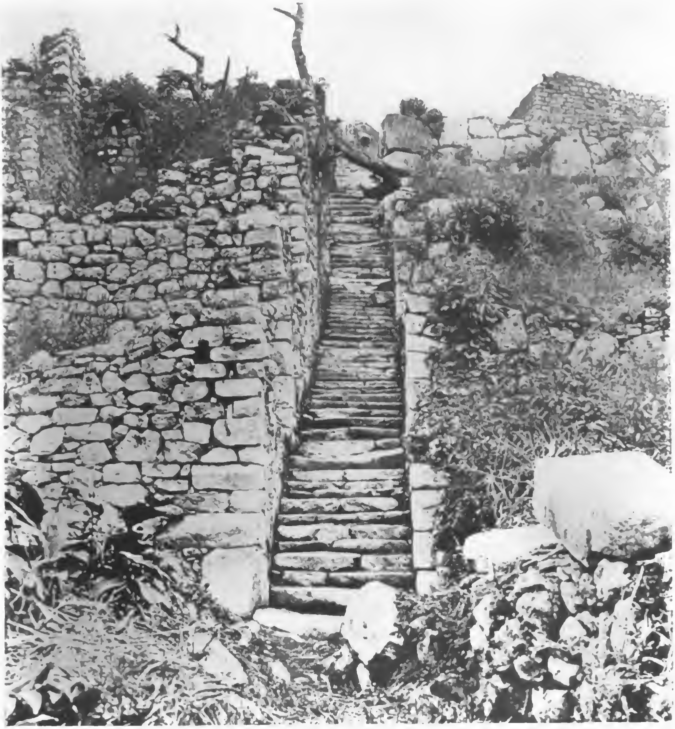


Photo by Hiram Bingham

A STAIRWAY ON THE MAIN STREET IN MACHU PICCHU

Within the city an extensive system of narrow streets and granite stairways made intercommunication relatively easy. This stairway is on the main cross street which connects the vicinity of the Sacred Plaza and the chief temples with the east city (see pages 456-459).

is most sincerely to be hoped that the Peruvian government will not allow the ruins to be overgrown with a dense forest, as they have been in the past.

Although the buildings are extremely well built, there is no cement or mortar in the masonry, and there is no means of preventing the roots of forest trees from penetrating the walls and eventually tearing them all down. In several cases we found gigantic trees perched on the very tips of the gable ends of small and beautifully constructed houses. It was not the least difficult part of our work to cut down and get such trees out of the way without seriously damaging the house walls (see pages 452, 453).

Considering all the pains that we took to preserve the ruins from further spoliation by the dense vegetation, it was

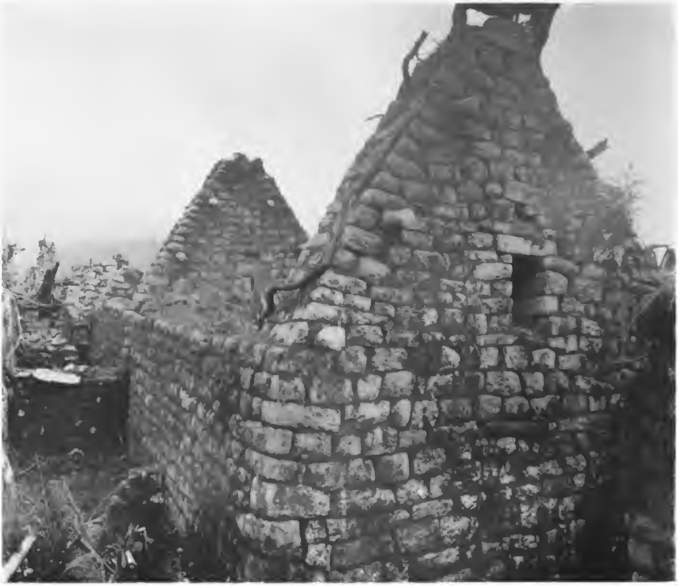


Photo by Hiram Bingham

A TYPICAL DWELLING HOUSE OF THE BETTER CLASS: MACHU PICCHU

One of the most striking characteristics of Machu Picchu architecture is that a large majority of the houses are of a story and half in height, with gable ends. These gables are marked by cylindrical projecting stones, carrying out the idea of the wooden rafters, which have disappeared. In the case of these two adjoining houses, the southern gables alone are still standing, the northern gables having been knocked off either by earthquakes or owing to the destructive forest vegetation. Had we not cleared the jungle and cut off the forest trees, the right gable would soon have gone with the weight of the tree that was perched on its peak, and whose roots can still be seen in the picture (see pages 455-456).

with frank and painful surprise that we read in the decree issued by the new Peruvian government, in connection with giving us permission to take out of Peru what we had found, a clause stating that we were not to injure the ruins in the slightest particular, and that we must neither deface nor mutilate them. I could not help being reminded of the fact that we had spent two days of one workman's time in erasing from the beautiful granite walls the crude charcoal autographs of visiting Peruvians, one of whom had taken the pains to scrawl in huge letters his name in thirty-three places in the principal and most attractive buildings.

We were greatly aided in the work of clearing the ruins by having with us for two months Lieutenant Sotomayor, of the Peruvian army, whose presence was due to the courtesy of President Leguia. Lieutenant Sotomayor took personal charge of the gang of Indians engaged in clearing the jungle and drying and burning the rubbish. As long as he was allowed to remain with us he did his work most faithfully and efficiently. It was with regret that we found he was relieved from duty at Machu Picchu in September.

AN IDEAL PLACE OF REFUGE

Although it is too early to speak definitely in regard to the civilization of Machu Picchu, a short description of the principal characteristics of the city may not be out of place.

Machu Picchu is essentially a city of refuge. It is perched on a mountain top in the most inaccessible corner of the most inaccessible section of the Urubamba River. So far as I know, there is no part of the Andes that has been better defended by nature.

A stupendous cañon, where the principal rock is granite and where the precipices are frequently over 1,000 feet *sheer*, presents difficulties of attack and facilities for defense second to none. Here on a narrow ridge, flanked on all sides by precipitous or nearly precipitous slopes, a highly civilized people—artistic, inventive, and capable of sustained endeavor—at some time in the remote past built themselves a city of refuge (pp. 436, 437).

Since they had no iron or steel tools — only stone hammers — its construction must have cost many generations, if not centuries, of effort.

Photo by Hiram Bingham

A DECORATED GABLE: MACHU PICCHU

A slightly different view of the gable end of one of the better houses, bringing out the location and size of the projecting cylindrical blocks.

Across the ridge, and defending the builders from attack on the side of the main mountain range, they constructed two walls. One of them, constituting the outer line of defense, leads from precipice to precipice, utilizing as best it can the natural steepness of the hill (see pages 438 and 439).

Beyond this, and on top of the mountain called Machu Picchu, which overlooks the valley from the very summit of one of the most stupendous precipices in the cañon, is constructed a signal station, from which the approach of an enemy could be instantly communicated to the city below. Within the outer wall they constructed an extensive series of agricultural terraces, stone lined and averaging about 8 feet high. Between these and the city is a steep, dry moat and the inner wall (see pages 441, 442, 444, 450).

When the members of an attacking force had safely negotiated the precipitous and easily defended sides of the moat, they would still find themselves outside the inner defenses of the city, which consisted of a wall from 15 to 20 feet high, composed of the largest stones that could be found in the vicinity—many of them huge boulders weighing many tons. This wall is carried straight across the ridge from one precipitous side to the other. These defenses are on the south side of the city (pp. 445-447).

THE TOWN WAS INVULNERABLE

On the north side, on the narrow ridge connecting the city with Huayna Picchu, strong defensive terraces have been strategically placed so as to render

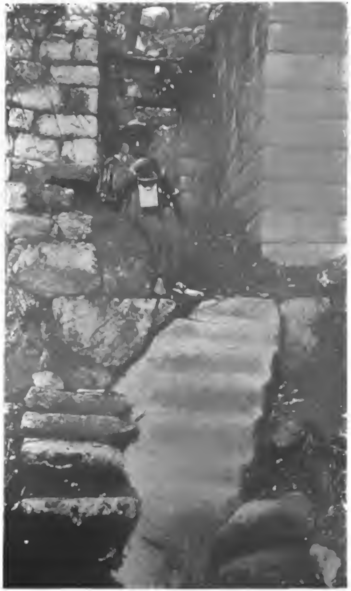


Photo by Hiram Bingham

A MONOLITHIC STAIRWAY: MACHU PICCHU

In some cases the smaller stairways are cut partly or entirely out of a single granite boulder. The stairway in this picture leads from the beautifully made houses of what has been termed the Princess Group, by reason of the exquisiteness of the stone work, down to the more roughly made houses probably once occupied by the retainers and the less important members of the family which occupied the [illegible] of the city

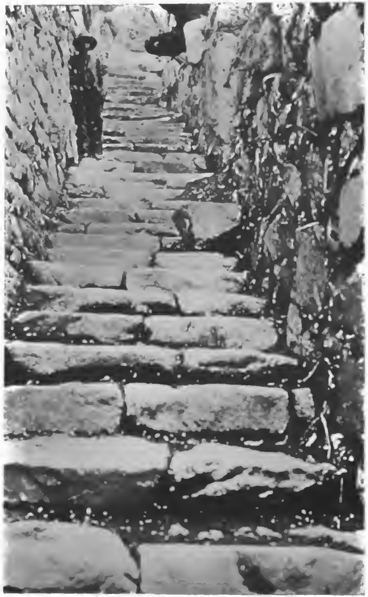


Photo by Hiram Bingham

A WELL-BUILT GRANITE STAIRWAY: MACHU PICCHU

Apart from the unusual number of windows in the houses of Machu Picchu, the most remarkable thing is the number of granite stairways, there being over 100, large and small, within the walls of the city. This is a portion of one of the more important stairways on one of the principal streets in the city

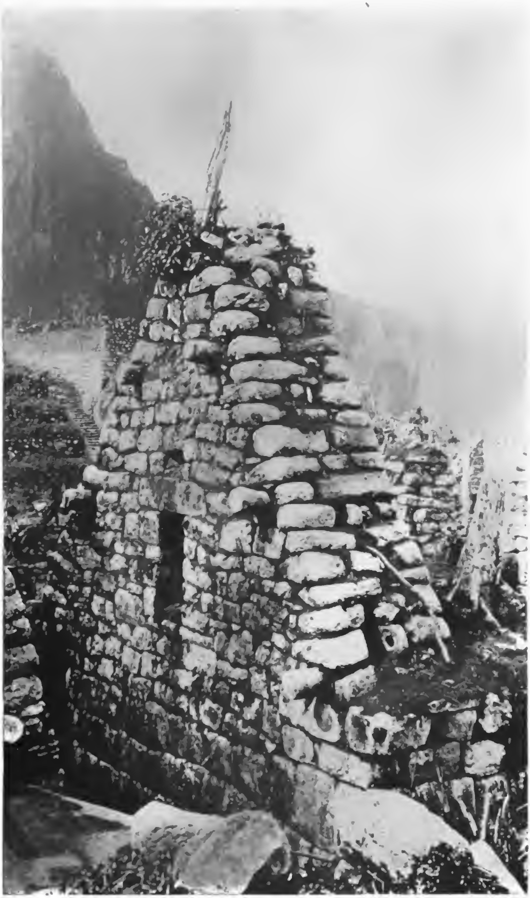


Photo by Hiram Bingham

THE WEST GABLE IN THE BEST HOUSE OF THE KINGS GROUP

Showing the second story window, a small ventilating window above it, the usual projecting cylinders, and the location of four ring-stones to which the rafters were tied. The ring-stones are located at regular distances. The holes in the stones were probably bored by means of pieces of bamboo, sand, water, a pair of good hands, considerable time, and a great deal of patience (see page 456).

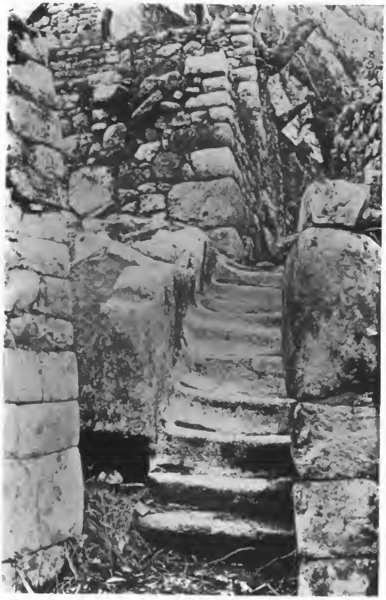


Photo by Hiram Bingham

ANOTHER MONOLITHIC STAIRWAY: MACHU PICCHU

In this case not only the steps of the stairway, but also the balustrades, were cut out of a single stone. Imagine the patience required to do this, when the only tools at hand were hard cobble stones that had to be brought up from the river 2,000 feet below.

nil the danger of an attack on this side. Difficult to reach at best, the city's defenses were still further strengthened by the construction of high, steep walls wherever the precipices did not seem absolutely impassable (see page 450).

Inside the city the houses are crowded close together, but an extensive system of narrow streets and rock-hewn stairways made intercommunication comfortable and easy.

On entering the city, perhaps the first characteristic that strikes one is that a large majority of the houses were a story and a half in height, with gable ends, and that these gable ends are marked by cylindrical blocks projecting out from the house in such a way as to suggest the idea of the ends of the rafters. The wooden rafters have all disappeared, but the ring-stones to which they were tied may still be seen in some of the pictures, notably that on page 455.

These ring-stones consist of a slab of granite, about 2 feet long and 6 inches wide by 2 inches thick, with a hole bored in one end, and were set into the sloping gable wall in such a way as to be flush with the surface, although the hole was readily accessible for lashing the beams of the house to the steep pitch of the gables. There were usually four of these ring-stones on each slope of the wall. Dr. Eaton found this to be also a feature of the Choqquequirau architecture, only in that city the number of ring-stones is larger per gable.

A CITY OF STAIRWAYS

The next most conspicuous feature of Machu Picchu is the quantity of stairways, there being over 100, large and small, within the city. Some of them have more than 150 steps, while others have but 3 or 4. In some cases each step is a single block of stone 3 or 4 feet wide. In others the entire stairway—6, 8, or 10 steps, as the case might be—was cut out of a single granite boulder (see pp. 451, 454, 457-9).

Again, the stairway would seem almost fantastic, being so narrow and wedged in between two boulders so close together that it would have been impossible for a fat man to use the stairway at all. In no case were the stairways intended for ornament. In every case they are useful in getting to a location otherwise difficult of access (page 458).

The largest level space in the city was carefully graded and terraced, so as to be used for agricultural purposes, on the products of which the inhabitants could fall back for a time in case of a siege.

It seems probable that one reason why

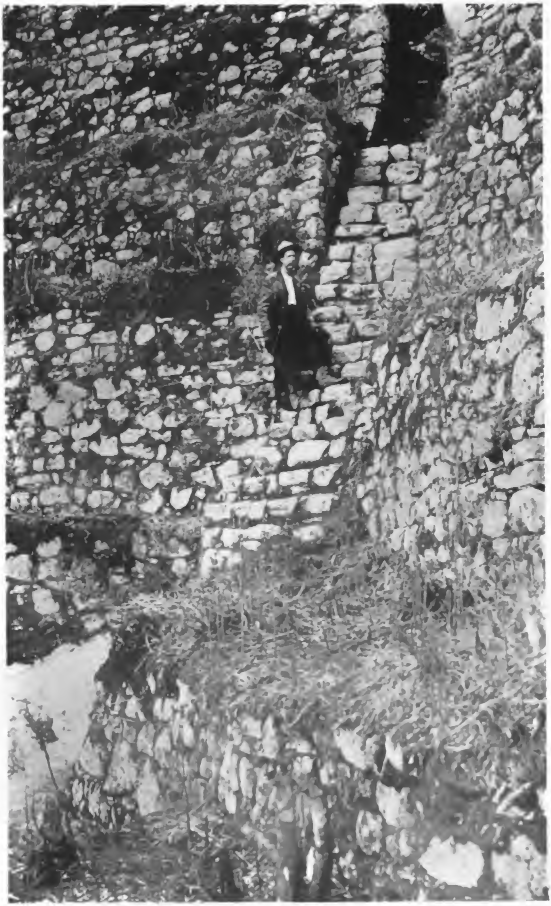


Photo by Hiram Bingham

THE STEEPEST STAIRWAY IN MACHU PICCHU

This stairway is one of those connecting the various agricultural terraces, and as it was in a position where it was not needed to be used for constant traffic, as in the streets of the city, it was left to follow the extremely steep natural declivity of the hill.

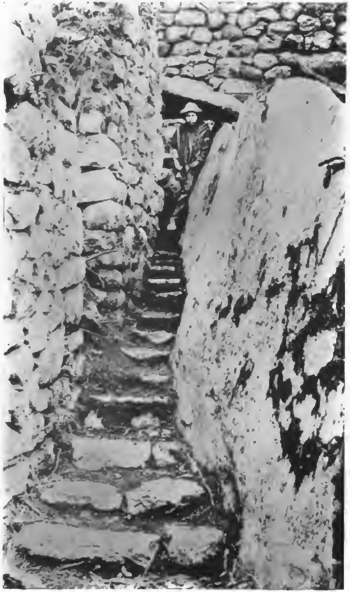


Photo by Hiram Bingham

THE NARROWEST STAIRWAY: MACHU PICCHU

Every square foot of ground in the city was utilized for some purpose or other. Sometimes a garden was tucked into a little area not more than 8 feet square behind and above a dwelling-house. To reach these out-of-the-way gardens, narrow, almost fantastic, stairways were constructed. This one could not have been used with comfort by any but a small workman like the boy in the picture.

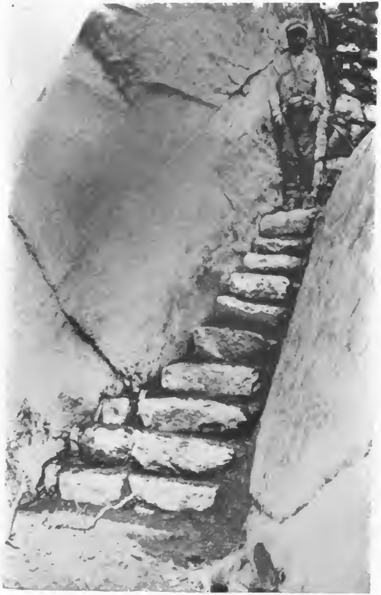


Photo by Hiram Bingham

A SMALL PRIVATE STAIRWAY IN MACHU PICCHU

Another little stairway ingeniously constructed between two granite ridges in order to make accessible a little garden terrace the city was deserted was a change in climate, resulting in scarcity of water supply. At the present time there are only three small springs on the mountain-side, and in the dry season these could barely furnish water enough for cooking and drinking purposes for 40 or 50 people. There could never have been very much water here, for the *azequias*, or water channels, are narrower than any we have ever seen anywhere else, being generally less than 4 inches in width.

THE FOUNTAINS ON THE STAIRWAY

We were able to trace the principal *azequia* from the vicinity of the springs along the mountain-side for a distance of perhaps a mile, across the dry moat on a slender bridge, then under the city wall, along one of the terraces, and finally to the first of a series of fountains or baths, located on the principal stairway of the city (see picture on this page).

This stairway is divided to admit the entrance of one of the fountains, of which there are 14 or 15 in the series. Each basin is about 2½ feet long by 1½ feet wide and from 5 to 6 inches in depth. In some cases the basin and the floor of the bath-house, or fountain, is made of a single slab of granite. Generally holes were drilled in one of the corners of the basin to permit the water to flow through carefully cut underground channels to the next basin below.

The Peruvians call these fountains "baths." It does not seem to me likely that they were used for this purpose, but rather that, by a careful husbanding in basins of this sort, the water-pots of the inhabitants could the more readily be filled by any one coming to one of the fountains.

Many of the houses are built on terraces on the steep sloping hillsides. In such case their doors face the hill and the windows look out on the view. Most of the houses are well provided with niches, the average size being about 2 feet in height by 1¼ feet in width. In some interiors projecting cylindrical blocks are found alternating between the niches. In a few houses we found evidence of stucco, but in most cases the mud plaster had entirely disappeared (see page 463).

Possibly the most interesting conclusion brought out as a result of our extensive clearing and excavating is that

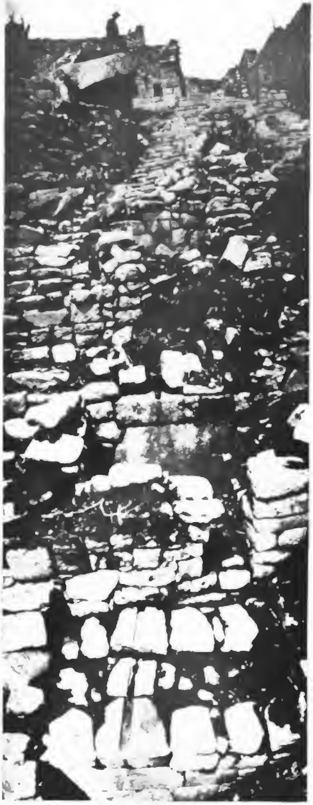


Photo by Hiram Bingham

THE STAIRWAY OF THE FOUNTAINS: MACHU PICCHU

The longest and most important stairway is so arranged as to admit the entrance of fountains, of which there are 14 or 15 in a series. As they had no pipes, the builders conducted the water in skilfully made stone conduits, carrying the stream from basin to basin, sometimes under the stairway and sometimes at its side (see pages 460-461).

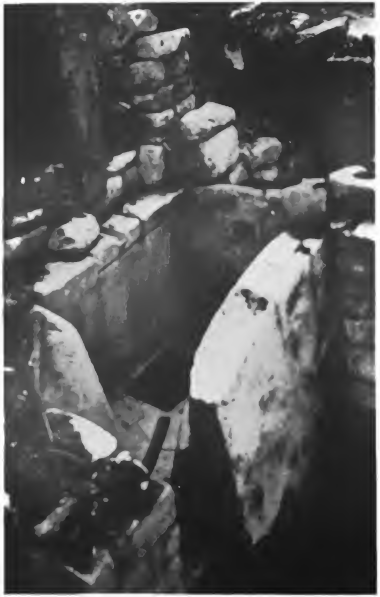


Photo by Hiram Bingham

THE UPPERMOST FOUNTAIN: MACHU PICCHU

The basins of the fountains are usually cut out of a single block of granite, which forms part of the floor. Frequently, as in the fountain shown in the picture, one or two small niches were constructed in the side walls and a small lip was cut in the stone at the end of the conduit, so as to enable the water to fall clear of the back wall of the fountain (see page [illegible]).

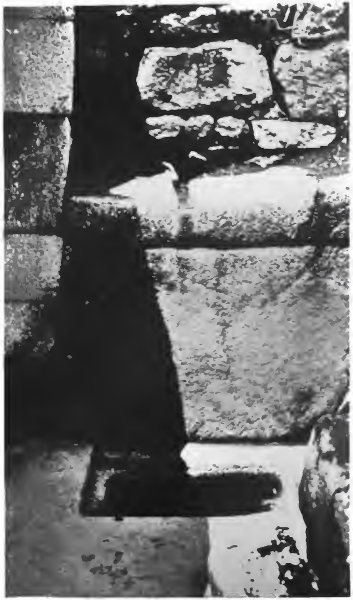


Photo by Hiram Bingham

A FOUNTAIN AT MACHU PICCHU

Another fountain showing the end of the conduit and the monolithic basin. The water passed out of the basin through a hole drilled in one corner and connecting with the underground conduit below.

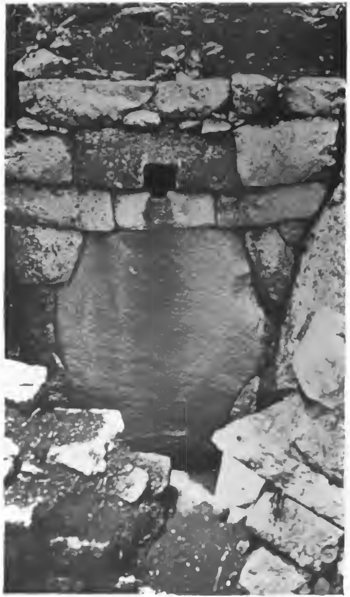


Photo by Hiram Bingham

A FOUNTAIN AT MACHU PICCHU

Another fountain showing the opening of the conduit. Owing to a change in climate, the springs which formerly fed these fountains are now so small as to give scarcely water enough for three families, except in the wet season.

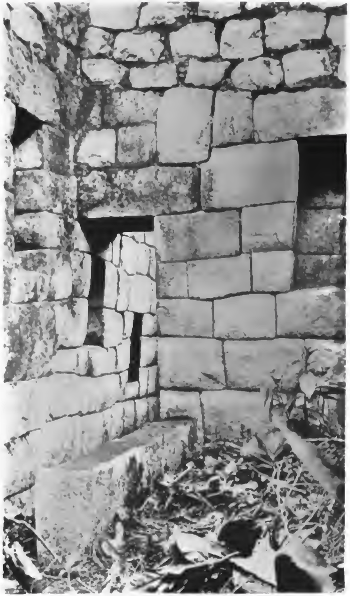


Photo by Hiram Bingham

INTERIOR OF ONE OF THE BEST HOUSES: MACHU PICCHU

Houses with more than one room were scarce, but where this does occur, the doors, as in the picture, are very small

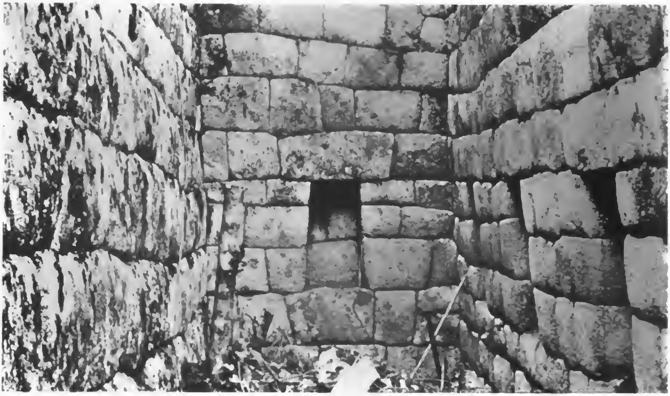


Photo by Hiram Bingham

TYPICAL INTERIOR OF SMALL CHAMBER IN BETTER CLASS HOUSE: MACHU PICCHU

Most of the houses are well provided with niches, the average size being about 2 feet in height and a foot and a quarter in width. These niches took the place of closets, wardrobes, shelves, and tables. They were usually symmetrically arranged and offered a pleasing break in the dull finish of the solid walls.

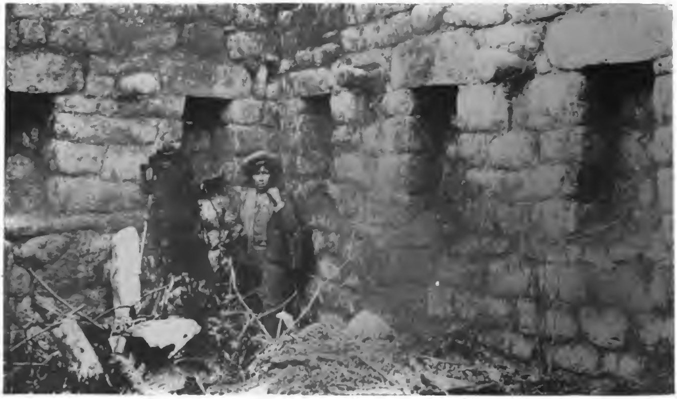
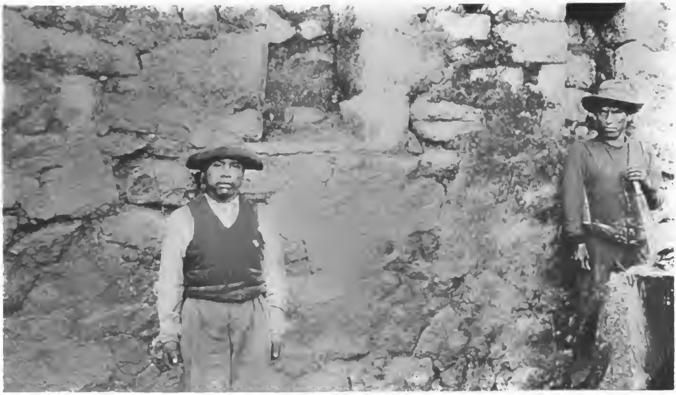


Photo by Hiram Bingham

ANOTHER TYPICAL INTERIOR: MACHU PICCHU

In many of the houses there are round or square stones projecting between the niches. In some cases these were used to support an upper story, while in other cases they are either for ornament or merely convenient hooks on which to hang ponchos, slings, ropes, etc.



Photos by Hiram Bingham

STUCCO STILL IN POSITION: MACHU PICCHU

Some of the houses were lined with such beautiful stone work as to require no other finish. In others it seems probable that the roughly finished stones were covered with some kind of mud or plaster. The picture shows the only house in Machu Picchu where considerable portions of this plaster still remain on the walls (see page 471).

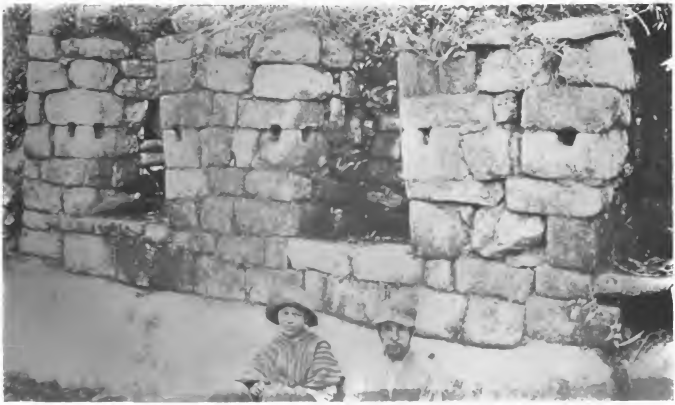


Photo by Hiram Bingham

AN UNUSUAL GROUP OF NICHES: MACHU PICCHU

In this house, or temple, the niches are of unusual form. The picture shows three, each one of which contains three little niches, and also has devices whereby it could have been closed by a bar fastened to the corner stones.

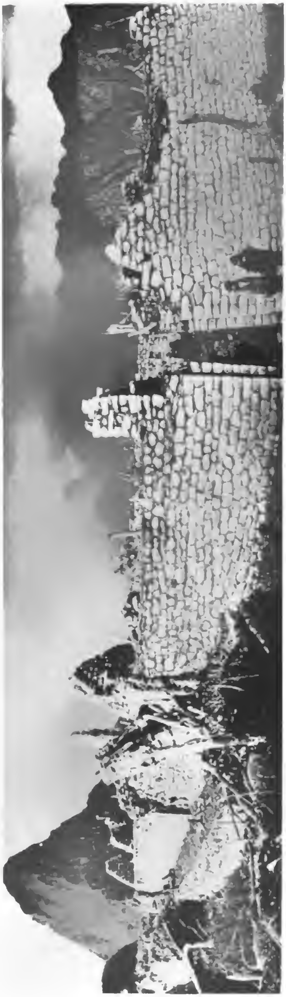


Photo by Hiram Bingham

TYPICAL HOUSES AT MACHU PICCHU

This picture shows a part of the east portion of the city and the entrances to clan groups (see text, pages 459 and 464). One of the principal streets in the city runs along the terrace just outside the walls of the houses

the city was at one time divided into wards or clan groups (see page 468). Each one of these groups has but one entrance, a gateway furnished with the means of being solidly fastened on the inside. None of the doors to houses or temples have this locking device, but all the entrances to the clan groups have it, and the same device occurs in the principal gate to the city.

INGENIOUS BOLTING OF THE GATES TO THE CLAN GROUPS

The doors have disappeared, but probably consisted of rough-hewn logs of hard wood. They seem to have been fastened by two bars crossed at right angles. The upright bar was probably tied at the top to a ring-stone set in the wall and projecting from it above the stone lintel of the doorway (see page 465). It could have been fastened at the bottom by being set into a shallow hole in the ground. The cross-bar was lashed to stone cylinders about 6 inches high and 3 inches in diameter, set into lock-holes in the door-posts (pp. 466-7).

This ingenious device varies in different groups, but in general the principle is the same. The more common method of making these locks was to cut a hole out of the top or corner of one of the larger blocks in the door-posts and set the stone cylinder into saucer-shaped depressions below and above. Thus the cylinder would be so firmly keyed into the wall that it would be able to resist at least as much pressure as the hardwood cross-bar which was lashed to it.

Each one of the clan groups has certain distinctive features. In one of them, characterized by particularly ingenious stone-cutting, the lock-holes were cut in the center of solid granite rectangular blocks (see pages 470, 471). The picture on page 471, taken after the top block had been removed, shows the saucer-shaped depression cut into the upper stone. It also explains how the ingenious architect had carved the cylindrical block and the

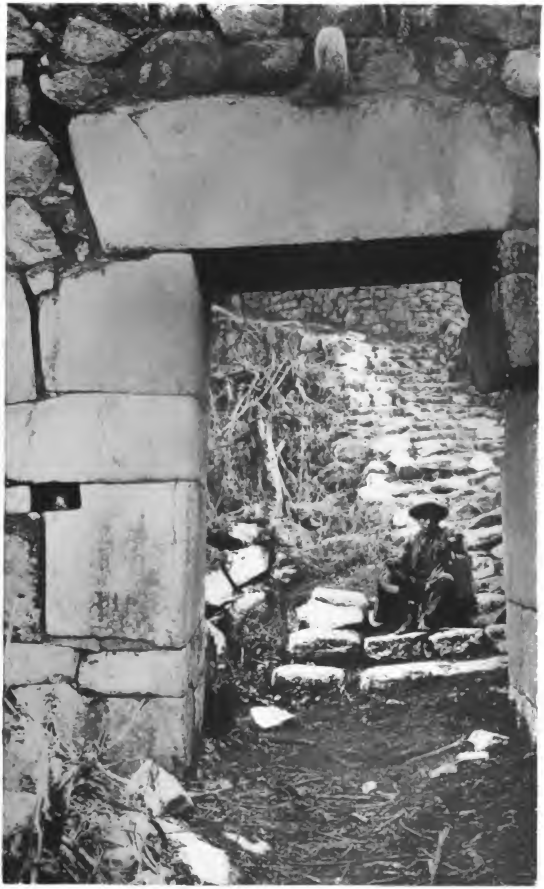


Photo by Hiram Bingham

THE CITY GATE: MACHU PICCHU

The doors to the houses had apparently no means of being fastened, but the entrances to the clan groups and the main city gate, whose interior is here shown, had lock-holes containing granite cylinders to which a strong bar could be fastened back of the gate (see pages 466 and 467). The ring-stone above the stone lintel at the top of the picture was used to secure the upright bar (see pages 464 and 466).

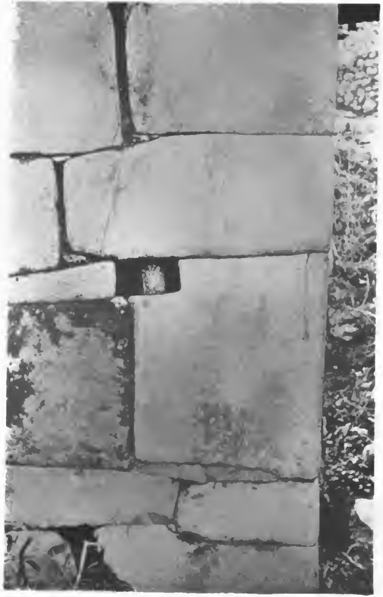


Photo by Hiram Bingham

THE LOCK IN THE CITY GATE: MACHU PICCHU

A nearer view of one of the lock-holes in the east door-post of the city gate shown on page 465

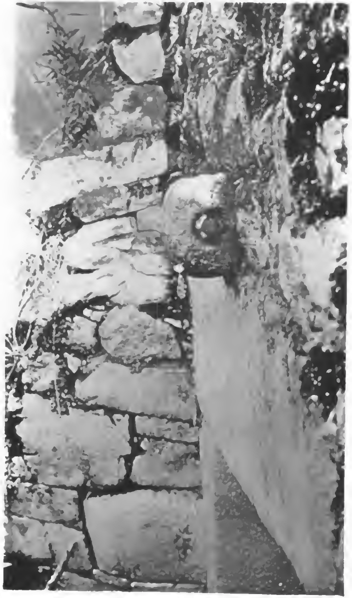
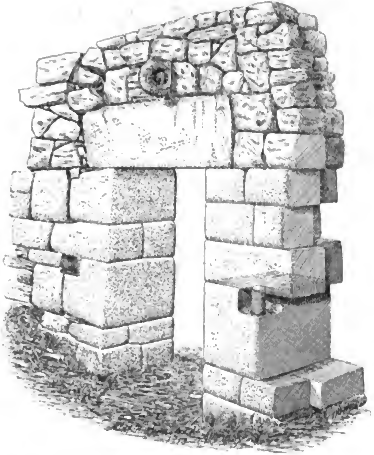


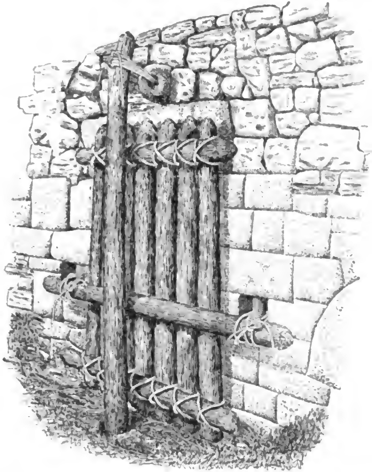
Photo by Hiram Bingham

A DETAIL OF THE CITY GATE: MACHU PICCHU

Above the gate and fastened into the wall above the stone lintel was a ring-stone from which the gate might have been swung, or to which one of its fastenings might have been secured



THIS DRAWING OF A SECTION OF THE CITY WALL AND THE CITY GATE SHOWS HOW THE STONE CYLINDERS (SEE PAGE 466) WERE SET INTO THE GATE-POSTS



AN IMAGINARY DRAWING SHOWING HOW THE CITY GATE MIGHT HAVE BEEN CLOSED (SEE PAGES 464-466)

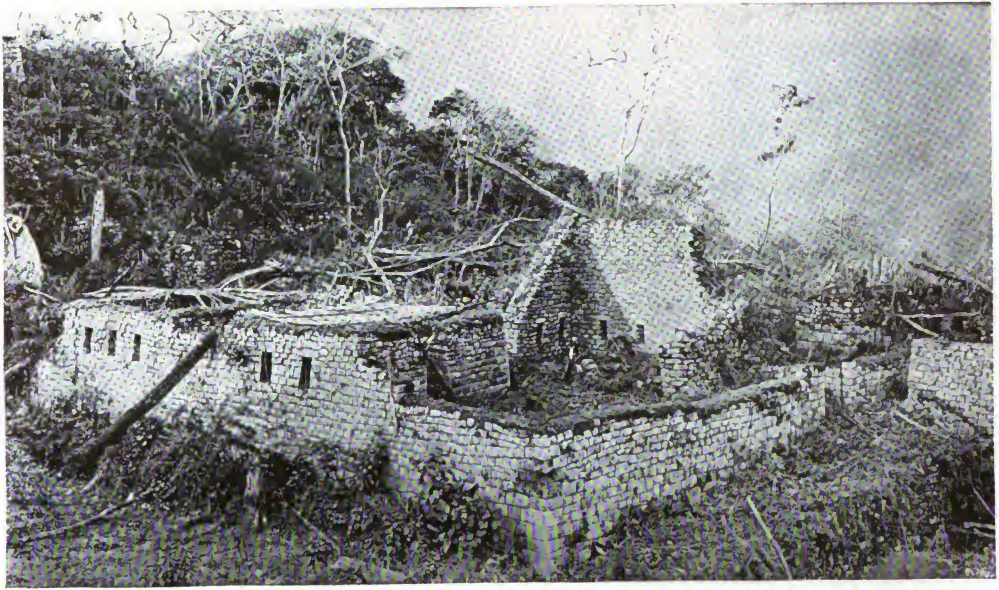


Photo by Hiram Bingham

ONE OF THE WARDS OR CLAN GROUPS INTO WHICH THE CITY WAS ONCE DIVIDED (SEE PAGE 464)

The city of Machu Picchu was occupied by various clans or family groups. Each one of them has from six to ten houses, and each group of houses is characterized by some peculiarity. In the case of the group shown in the picture, this peculiarity consists of particularly ingenious stone-cutting, examples of which are shown in the pictures on pages 471, 472, 473, 474, etc.).

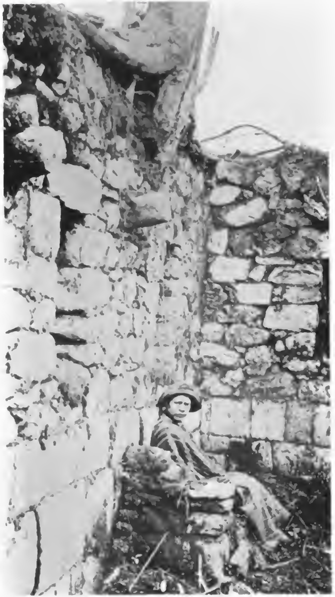


Photo by Hiram Bingham

A STONE SETTEE: MACHU PICCHU

It is not probable that the houses had much furniture, but in some cases there are raised stone platforms which were possibly used for beds, and in a few instances there are stone seats in the corners of the house, as shown in this picture.

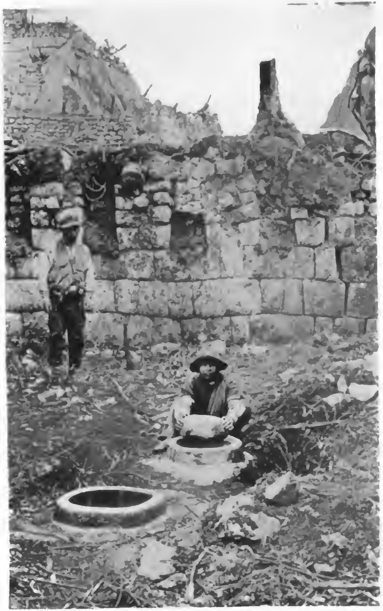


Photo by Hiram Bingham

MONOLITHIC KITCHEN UTENSILS: MACHU PICCHU

In the largest house of this "Ingenuity Group," mortars which could be used for grinding corn or frozen potatoes were carved out of boulders in the floor of the room. Lying near one of these was found the original rocking pestle still in use throughout the Andes of Peru. The boy has placed it on the mortar just as he would do if he were starting to make corn meal today.

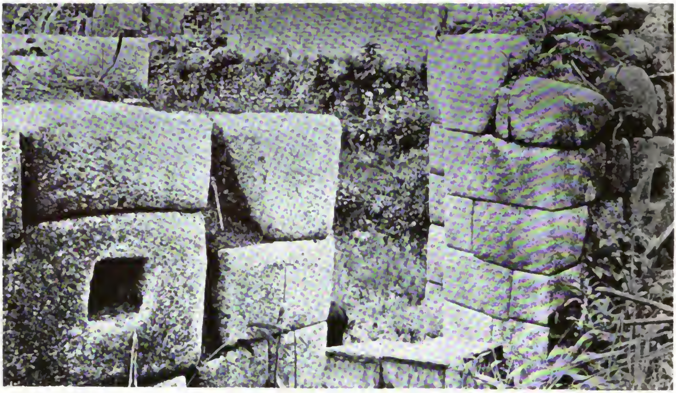


Photo by Hiram Bingham

THE MOST INGENIOUS LOCK IN MACHU PICCHU

The gateway to Ingenuity Group had lock-holes differing from those of other groups (see pp. 464, 466-467), in that they were cut out of single blocks of stone and had the stone cylinder not set into, but forming part of the whole block (see also page 471).

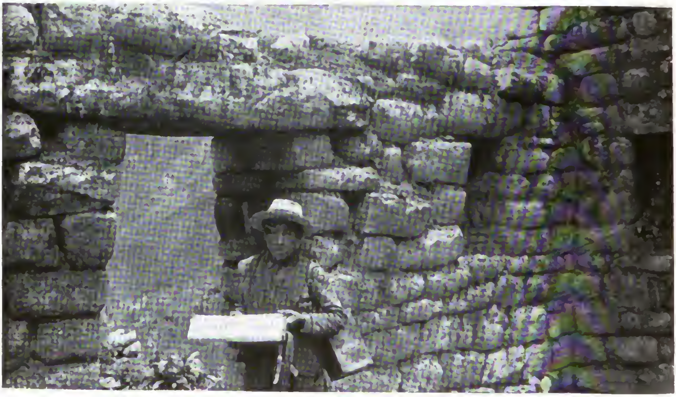


Photo by Hiram Bingham

A TYPICAL HOUSE DOOR: MACHU PICCHU

The doors of the houses were carefully made and are all narrower at the top than at the bottom. The lintels are usually made of two blocks of stone. The Indian boy in the picture is carrying the kodaks and a large map, in ten sheets, on which are shown all the houses.

lock-hole all out of one piece, thus making it much stronger than the average.

Granite boulders in the floor of the principal house in this group had their tops carved into kitchen utensils for grinding corn and frozen potatoes (see page 469). In this group also we found the only case of houses lined with stucco or plaster made of red clay (page 463), and here is the only gabled building divided into two parts by a party wall rising to the peak and pierced by three windows.

SOME EXQUISITE STONEWORK

Another group was distinguished by having its own private gardens on terraces so arranged that access to them could be had only by passing through the small collection of houses constituting this particular clan group. In another case, the entrance to a group notable for its very elaborate and exquisitely finished stonework, the upright cylinder in the lock-hole is brought flush with the surface of the stone and is a part of the block itself (see pages 478 and 479).

Another group is distinguished by having monolithic lintels for the doorways (see page 477). In this group also the gables are unusually steep (see page 478).

Nearly all the groups had what seemed to be a religious center, consisting of a more or less carved granite block in position. In several cases caves had been excavated under these rocks, and in one case the cave was beautifully lined with finely cut stonework (483-485). In this last cave a semicircular tower was constructed on the top of a boulder (485 and 496) and connected with it by the finest example of masonry in Machu Picchu (485 and 496).

This beautiful wall, shown on pages 487 and 488 and also on page 490, was made of specially selected blocks of beautifully grained white granite, and was constructed by a master artist. We grew more fond of this wall the longer we knew it, and every time we saw it it gave us a thrill of joy.

The detailed study (p. 488) of where the wall joins the next house wall shows how ingeniously the blocks were constructed, so as to form a brace which would prevent the house and wall from leaning apart and thus causing cracks to appear in the wall. The precision of line, the symmetrical arrangement of the blocks, and the gradual gradation in the tiers, with the largest at the bottom and the smallest at the top, combine to produce a wonderfully beautiful effect.

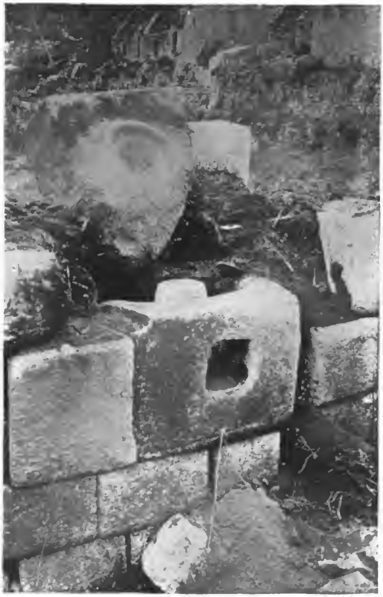


Photo by Hiram Bingham

THE MECHANISM OF THE LOCK

The left-hand lock-hole, shown in the upper picture on the preceding page, after its stone covering had been raised, showing the saucer-shaped depression in the capstone, enabling it to strengthen the stone cylinder of the lock. It was not only an ingenious, but a patient and devoted workman, who would take the trouble to make such a contrivance for securing himself and his family against intruders.

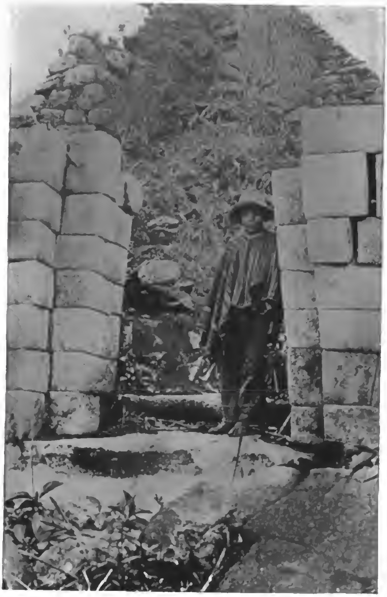


Photo by Hiram Bingham

THE ENTRANCE TO A CLAN GROUP: MACHU PICCHU

The exterior of the gateway to Ingenuity Group, showing the steps leading to it and the re-entrant angles in the door-posts, characteristic of nearly all the gateways to clan groups.

THE PROBABLE USE OF SNAKES FOR AUGURY

As will be seen from the photograph (see page 491), the wall is not perpendicular, but inclines inward at the top. This angle is characteristic of nearly all the vertical lines in the ruins. Doors, windows, and niches are all narrower at the top than at the bottom.

In the semicircular tower which connects with this fine wall the ingenious cutting of stones in such a way as to follow a selected curve reaches a perfection equaled only in the celebrated wall of the Temple of the Sun (now the Dominican Monastery), in Cuzco. Like that, it is a flattened curve, not round (p. 485).

One of the windows in this tower (see pages 492-494) has several small holes near the bottom. These were found to connect, by very narrow channels, barely large enough for a snake to crawl through, with circular holes within the wall, where the snakes might have constructed their nests.

There are still many snakes at Machu Picchu. There are also snakes carved on several rocks. (page 497). Lizards are not common, and the holes within the wall are much too large for lizards' nests; but they are of the right size for a comfortable snake's nest—for a small snake. It seems to me possible that in this wall the priest of this clan group kept a few tame snakes and that he used their chance exits out of one hole or another as a means of telling omens and possibly of prophesying.

The so-called *sacred plaza* is the site of two of the finest structures at Machu Picchu. One of these — the Temple of the Three Windows — has already been referred to: the other is a remarkable structure, about 12 feet in height, built around three sides of a rectangle some 30 feet long and 18 feet wide. A description is hardly necessary, as a better idea can be gained from the pictures (pp. 409, 501, 502, 503, and 512) than from any words of mine. Suffice it to say that it is marked by a very pleasing symmetry, by the use of tremendous blocks of granite, three of them being over 12 feet in length, and by the projection in an obtuse angle of the ends of the sides.

"THE PLACE TO WHICH THE SUN IS TIED"

On top of the beautifully terraced hill (pp. 498, 507, 508), behind this temple, is a stone, generally agreed to be an *intihuatana* stone, or sun-dial—the intihuatana being the "place to which the sun is tied." Similar stones were found by the Spanish conquerors in Cuzco, Pisac, and Ollantaytambo. An idea of this stone may be gained from the picture on page 509.

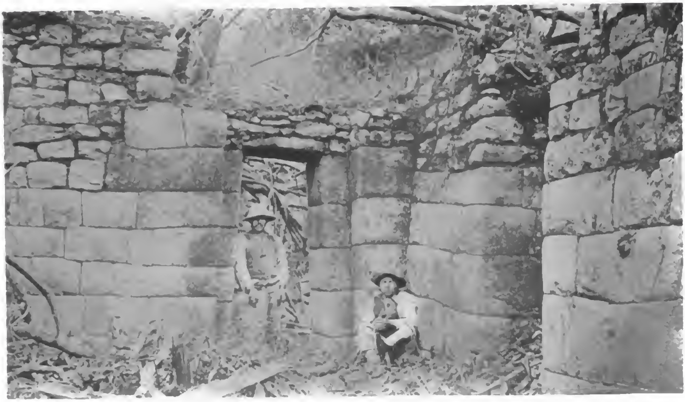


Photo by Hiram Bingham

A REST DURING PRELIMINARY CLEARING: MACHU PICCHU

A corner of Ingenuity Group, showing the entrance on the left to a subsidiary group and on the right to the house that has the stone mortars in its floor (see page 469)

Owing to the location of Machu Picchu in this extremely inaccessible part of the Andes, to its clearly having been a city of refuge, easily defended and suited for defensive purposes; owing to the presence of a large number of windows in the ruins, and particularly to the presence of three large windows in one of the principal temples, I believe it to have been the original Tampu Tocco, from which the Incas came when they started on that migration which led them to conquer Cuzco and to establish the Inca Empire.

The difficulties of life for several centuries in the Vilcabamba region would have been likely to have developed this ingenious and extremely capable race and given them strength of character. The influence of geographical environment is no small factor in developing racial characteristics. I hope at no distant future to prepare an exhaustive report of this wonderful city, whose charm can only dimly be realized from these pictures.

The beautiful blue of the tropical sky, the varying shades of green that clothe the magnificent mountains, and the mysterious charm of the roaring rapids thousands of feet below cannot be portrayed and can with difficulty be imagined.

THE PANORAMIC VIEW

The beautiful panoramic view of Machu Picchu, which accompanies this article as a Supplement, gives a good idea of the grand Cañon of the Urubamba as seen from Machu Picchu, of the sacred Plaza, and Intihuatana Hill, and of the East City.

Unfortunately, it was impossible to take a picture that would also include the other half of Machu Picchu, including the remarkable Upper City, with its rows of houses, each one on a separate terrace, the beautiful buildings of the Princess Group, and the splendid stonework of the King's Group. All of these are behind and to the right of one looking at this panorama. And still further behind are the agricultural terraces, our camp, and Machu Picchu Mountain; but these are all shown in separate views.

The Incas were, undeniably, lovers of beautiful scenery. Many of the ruins of their most important places are located on hill tops, ridges, and mountain shoul-

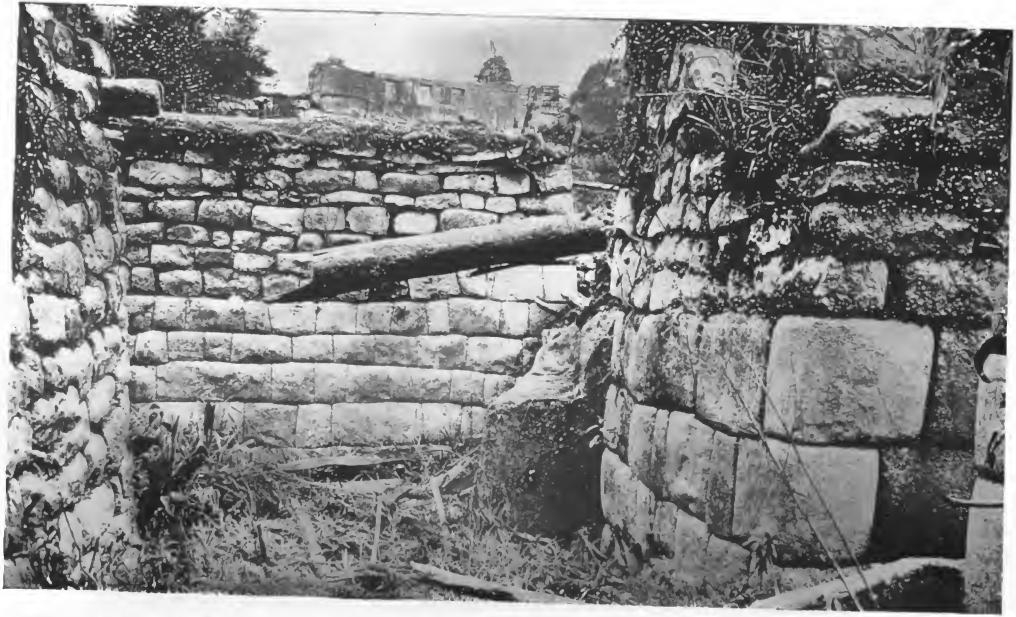


Photo by Hiram Bingham

A VIEW IN THE CENTER OF INGENUITY GROUP LOOKING ACROSS THE GARDENS TOWARD THE SACRED PLAZA AND THE TEMPLE OF THE THREE WINDOWS

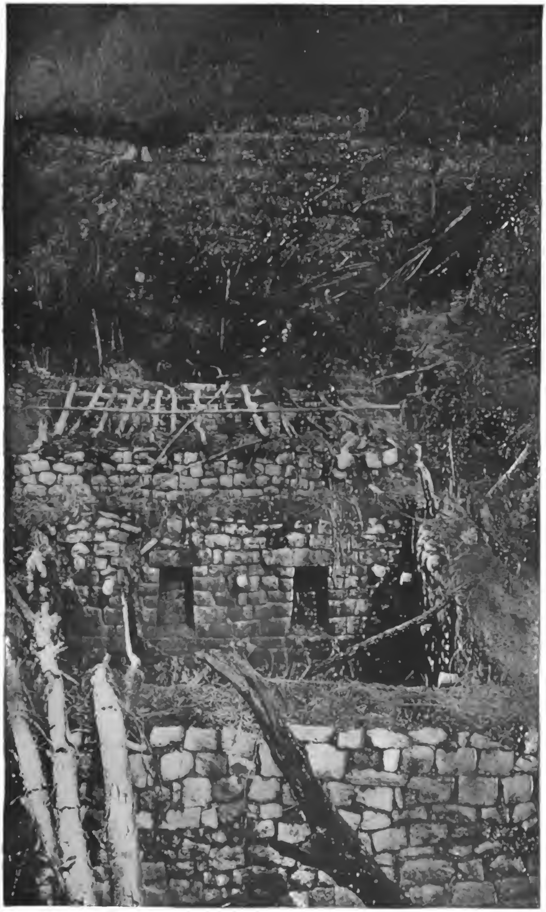


Photo by Hiram Bingham

A DISTANT VIEW OF OUR FIRST CAMP: MACHU PICCHU

A view looking over the tops of two of the houses of Ingenuity Group toward our camp and some of the agricultural terraces. The beams on top of one of the houses were placed there recently by one of our Indians, who thought this might make a good modern dwelling, but he found it too large for comfort. The huts of the modern Indians are much smaller than these houses and have no windows. It is possible that this may indicate that the climate has grown colder as well as dryer.

Photo by Hiram Bingham

HAVING DIFFICULTIES WITH A TRIPOD: MACHU PICCHU

A distant view of Ingenuity Group, with Private Garden Group above it, as seen from the vicinity of the semicircular tower. In taking these pictures, it was frequently necessary to put the tripod on the shaky peak of a ruined gable, a process not always easy.

Photo by Hiram Bingham

TYPICAL MASONRY: MACHU PICCHU

The outside wall of another group which was distinguished by having its own private gardens on terraces so arranged that access to them could be had only by passing through the houses of the group. These houses are built on a terrace whose retaining wall consists of large blocks of solid masonry. The smaller wall on top of this is merely a screen for defensive purposes. Notice the end of the stone conduit in the lower left-hand corner, enabling the courtyard of this group to be properly drained.

ders, from which particularly beautiful views can be obtained.

Remarkable as is the architecture of Machu Picchu, and impressive as is the extent of the stone-cutting done by a people who had no steel or iron tools, neither of these things leaves more impression on the mind of the visitor than the inexpressible beauty and grandeur of the surroundings.

A reconnaissance of the forestration of the immediate vicinity and a large scale map of Machu Picchu and its vicinity were made by Assistant Topographer Stephenson. From the map we hope some day to be able to construct a model which will give those not fortunate enough to visit this marvelous place some idea of its character and beauty.

FORESTRATION OF THE REGION

In regard to the forestration of the region, Mr. Stephenson reports that tree-growth begins about midway between the source and the mouth of the Urubamba River. Forests frequently interrupted by open areas occupy the lower half of the valley. The open bottoms are moist, untimbered, and used for agriculture. In these the soil is a deep sandy loam, rich in humus and having abundant moisture.

The valley is very narrow, with many tributaries, and rough precipitous sides frequently broken by cliffs. The lower slopes have fairly rich soil and abundant moisture. They extend for several hundred feet above the river. Above them the soil is regularly dry and poor. Although rainfall is abundant, the sunny north slopes have a dry rocky soil.

The forest in the Machu Picchu region is made up of subtropical hardwoods, with probably more than 30 species in the stand. Good growth is confined to the valley bottoms and the lower slopes. On the shaded slopes the forest sometimes extends to a point 2,000 feet above the river, and in narrow, protected valleys even higher; but on the upper slopes the trees are of poor form, gnarled and stunted.

On the ridges some trees occur, but they are very scrubby and do not form a canopy. Timber-line here is at elevation of about 10,000 feet above sea-level. The elevation of the river near Machu Picchu is about 6,500 feet above sea-level.

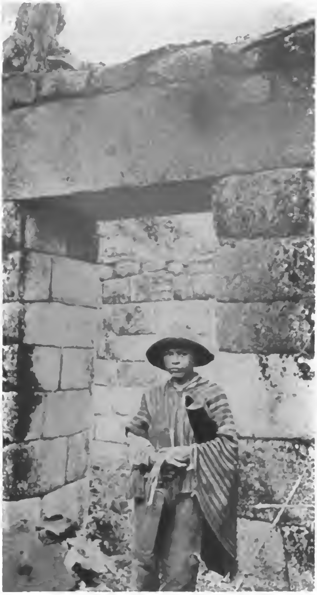


Photo by Hiram Bingham

THE FINEST DOORWAY AT MACHU PICCHU

One of the monolithic lintels in the group distinguished also by having unusually steep gables. In the other groups the houses almost invariably had duolithic lintels, but the chief of this clan determined to overcome the mechanical difficulties involved in placing a solid block weighing three tons on top of his doorpost and fitting it accurately to them. As he had neither cranes nor pulleys, but only levers and inclined planes, it must have required a prodigious amount of patient effort. This group we named the King's Group on account of the extraordinary solidity of the stonework.

Owing to the large number of species, the quality of the timber varies greatly. Many of these species produce nard, durable wood of fine texture that takes good polish. Other quick-growing species produce woods of inferior quality—soft, brittle, quickly decaying, and of little value for anything but rough lumber.

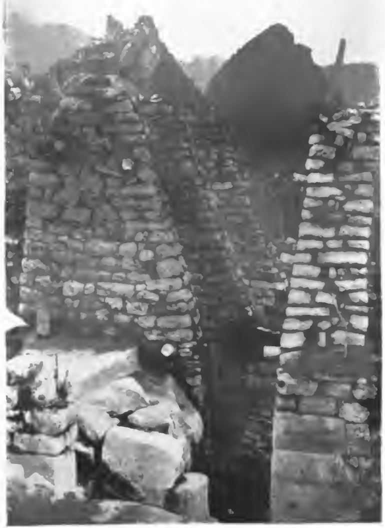


Photo by Hiram Bingham

STEEP GABLES AT MACHU PICCHU

The steep gables of the King's Group are, with the monolithic lintels, the distinguishing characteristic of this collection of houses

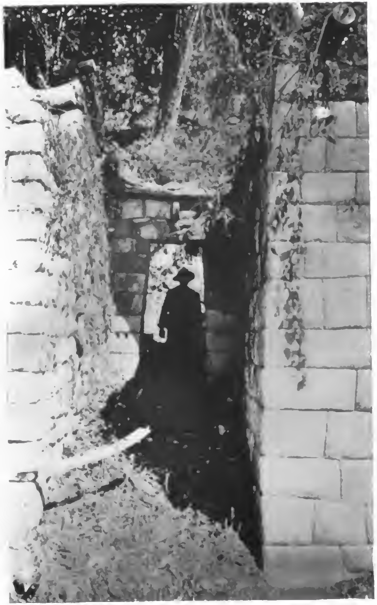


Photo by Hiram Bingham

AN ATTRACTIVE CORNER: MACHU PICCHU

The entrance hallway to the Princess Group, showing the interior of the gateway, where the upright cylinder in the lock-hole is brought flush with the surface of the door post (see also following page).

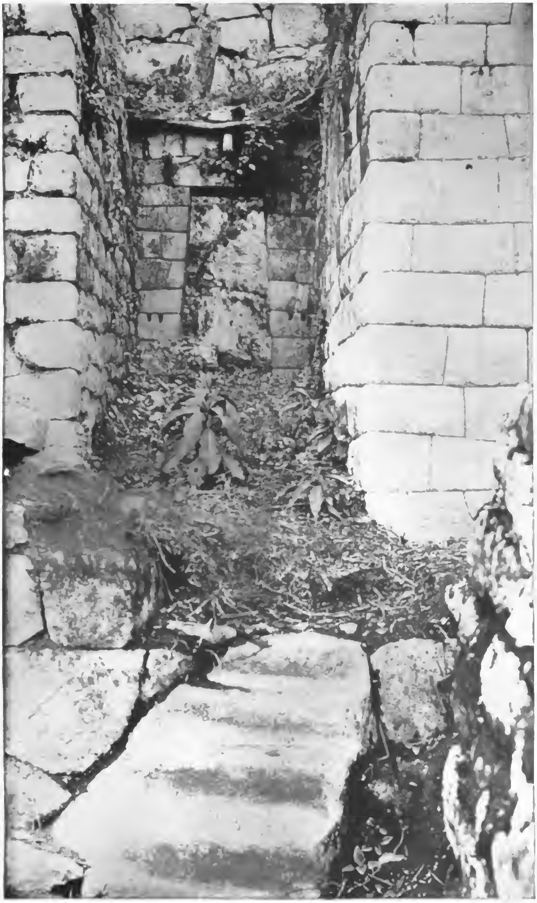


Photo by Hiram Bingham

THE SAME AFTER EXCAVATING

Another view of this hallway after excavation had shown a monolithic stairway at the end of it

Photo by Hiram Bingham

IN THE KING'S GROUP: MACHU PICCHU

A portion of the interior of this group, showing the great care exercised in the stone-fitting

NOTES ON THE TIMBER

All species are infected with parasites and all ages of trees seem to be subject to them. The worst damage is done to the fast-growing young trees.

In the bottoms the trees are tall, clean, and straight, running up to over 100 feet in height and 3 feet in diameter. The average is about 18 inches in diameter and 80 feet in height. On the lower slopes the growth is more uniform, with a slightly lower average size. There are a few healthy patches of timber, but they are only of occasional occurrence and limited to a few areas.

The timber in the valley bottoms averages 5,000 board-feet per acre, with a maximum of 10,000 over limited areas. On the slopes the average is 3,000 board-feet, with little variation. These are conservative ocular estimates.

The rugged character of the country makes logging of any but timber in bottoms impracticable. Trails are few and very bad; labor is scarce and uncertain. Should a railroad enter the valley as planned it will be possible to carry on profitable logging operations with portable mills. There is a good supply of timber for ties.

The next thing to be done would be to make a collection of samples, so that the qualities of the various hardwoods might be tested. Such tests would bring out definite facts about their value. Some of them are undoubtedly woods of high technical qualities as well as of beautiful grade and color.

Mr. Stevenson's map of Machu Picchu, the result of a three months' survey, is on a scale of 1 inch = 20 feet, with a contour interval of 10 feet, and consists

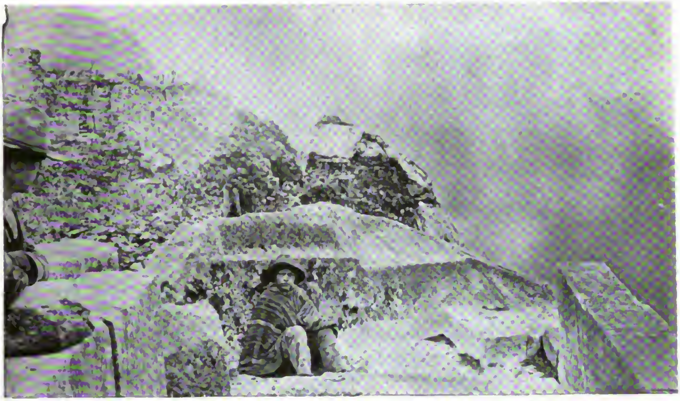


Photo by Hiram Bingham

A SACRED ROCK: MACHU PICCHU

Nearly all the clan groups had what seems to have been a religious center, consisting of a granite boulder or ledge carved into seats and platforms

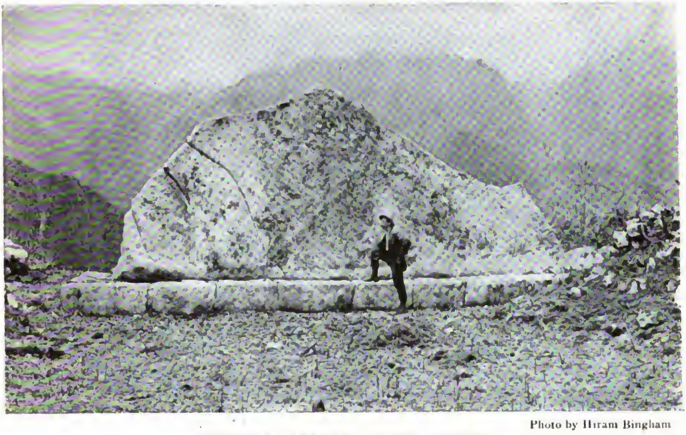


Photo by Hiram Bingham

ANOTHER SACRED ROCK: MACHU PICCHU

One of these sacred rocks is only 2 feet in thickness, although 15 feet high and 30 feet in length (see page 471)

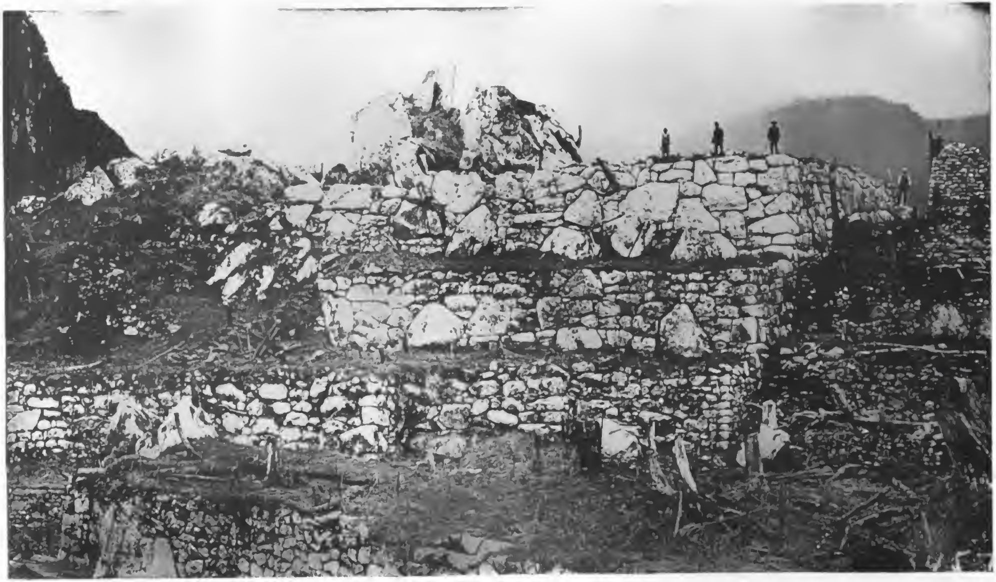


Photo by Hiram Bingham

A SACRED ROCK GROUP SURROUNDED BY TERRACES FACED WITH EXTRAORDINARILY LARGE ROCKS

It must have required a tremendous amount of ingenuity and a small army of laborers to get these huge rocks fitted into place

Photo by Hiram Bingham

THE INTERIOR OF A CAVE UNDER A SACRED STONE: MACHU PICCHU

Under the sacred stones frequently caves were constructed and in some cases lined with beautifully cut stones. This is a flashlight of such a cave underneath the semicircular tower (see page 471, and pictures, pages 484, 485, and 496).

of 16 large sheets. It should prove very useful in helping us to gain a correct idea of this wonderful city, which seems to have escaped the notice of the Spanish conquerors and to have remained practically unknown until it was first visited by the present writer in July, 1911.

OTHER IMPORTANT INCA RUINS

It is still too early to make definite statements in regard to the importance of this discovery; in fact, such opinions can only be passed by archæological experts after the full report of the work at Machu Picchu has been prepared and published. This much, however, can be said in regard to the superiority in extent and interest of Machu Picchu over previously discovered Inca ruins:

The most important Inca ruins heretofore discovered are in the city of Cuzco, the town and fortress of Ollantaytambo, Pisac, and on the islands of Lake Titicaca. There are, besides these, on the coast a number of localities like Pachacamác, Nazca, Ancon, Trujillo, and the country of the Grand Chimu, where the chief interest lies in the extensive findings of mummies, pottery, textiles, and metal ornaments, including gold, silver, bronze, etc. All of these places, however, were known to the Spanish Conquerors, and have been ransacked by treasure hunters from the earliest times.

Cuzco, the most important place of all, was adopted by the Spaniards as their most important city outside of Lima. They entirely remade the city, using large quantities of the ancient Inca walls to build their own palaces and churches. Although the city still has many Inca remains and retains a great charm for the tourist and the archæological student, it is more of a Spanish colonial city than of an Inca city.

The same is partly true of Ollantaytambo. The ruins of Pisac and many others in the vicinity, of which it is not necessary to give an account here, have repeatedly been ransacked by treasure hunters. The long palace at Vitcos, identified in 1911 as the last Inca capital, has been almost completely destroyed by these treasure hunters. Of the 30 beautiful door of cut granite, only two or three remain intact.

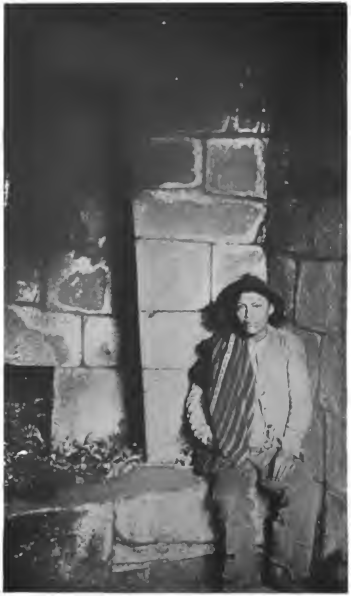


Photo by Hiram Bingham

THE CORNER OF THE CAVE

Another flashlight of the interior of the cave under the semicircular tower in the Princess Group

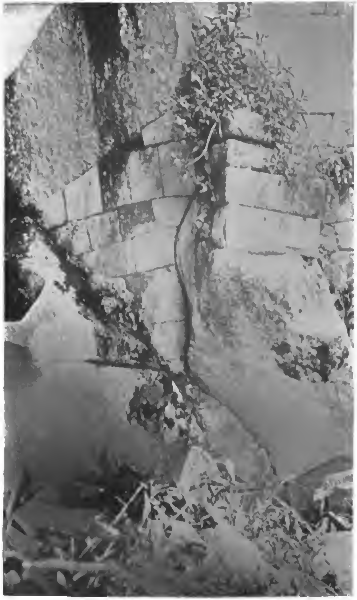


Photo by Hiram Bingham

AN EXTRAORDINARY PIECE OF STONE-FITTING: MACHU PICCHU

The entrance to the cave under the great rock on which rests the semicircular tower (see pages 485 and 406). Notice with what exquisite care and precision the space between the granite ledges has been filled with cut stone.

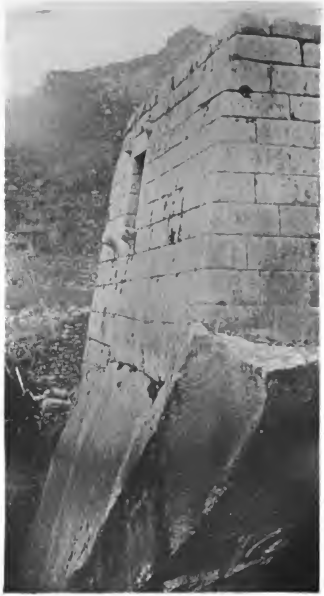


Photo by Hiram Bingham

ART JOINED TO NATURE AT MACHU PICCHU

The semicircular tower of the Princess Group resting on top of and built into a great granite boulder. Notice the precision of the stone-cutting in the little window and the four nubbins that decorate its corners (see text, page 471, and pictures, pages 496 and 484).

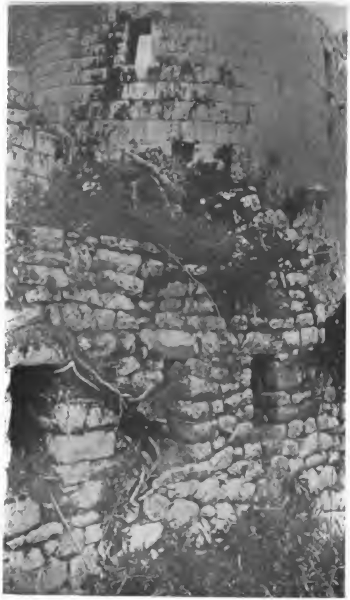


Photo by Hiram Bingham

AN EXTRAORDINARY TOWER: MACHU PICCHU

Another view of the semicircular tower of the Princess Group, showing the flattened curve of its architectural plan. The stones were cut with such precision and followed so exactly the selected curve that when they were put together they made a flattened curve whose perfection of detail is equaled only in the celebrated wall of the Temple of the Sun in Cuzco (see also pages 472, 489, and 490).

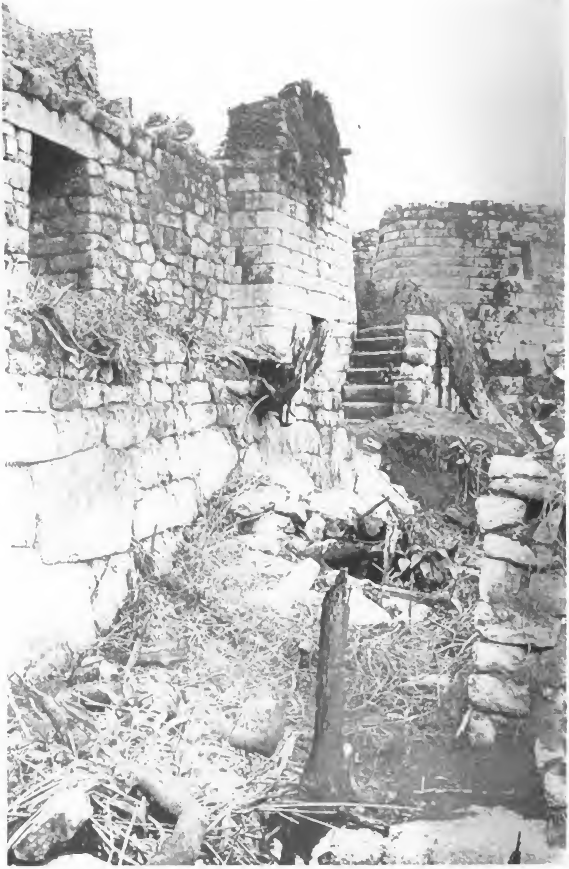


Photo by Hiram Bingham

IN THE PRINCESS GROUP: MACHU PICCHU

A general view of the Princess Group, showing the relation of the semicircular tower (on the right) to the other houses of the group. In the center of the picture is the only house in Machu Picchu consisting of two stories and a half. The stairway shown in the picture connects the first and second stories of this house.

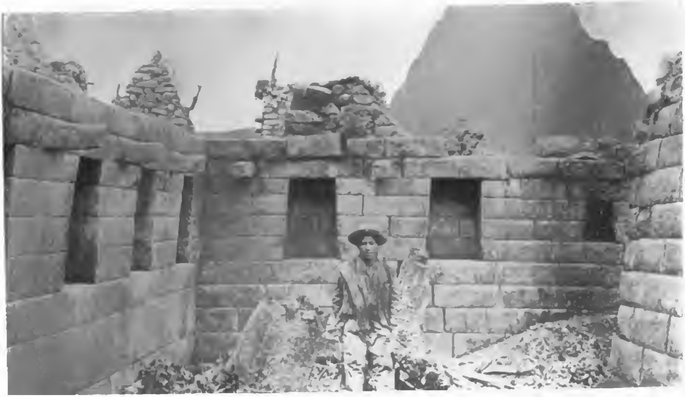


Photo by Hiram Bingham

AN EXAMPLE OF EXTRAORDINARY STONE-CUTTING: MACHU PICCHU

Connected with the semicircular tower is an ornamental wall made of specially selected blocks of beautifully grained white granite. The interior of the wall was ornamented by a series of symmetrical niches, between each one of which is a projecting stone roughly squared (see page 471).

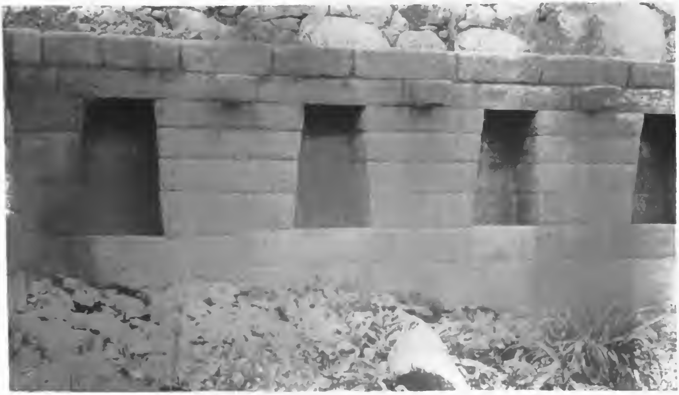


Photo by Hiram Bingham

REMARKABLE NICHES AT MACHU PICCHU

Another portion of the interior of the ornamental wall. Bear in mind that the ancient builders had no T squares nor right lines, and could approach straight lines only by the skill of a trained eye (see also page 488).

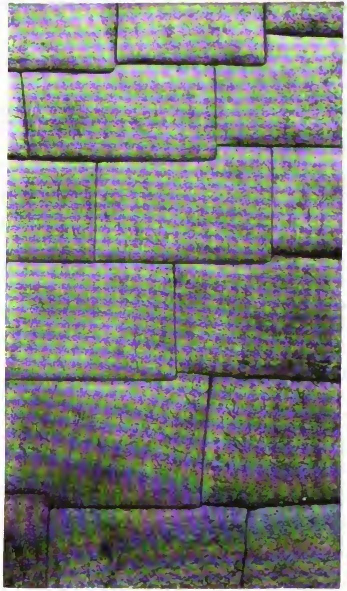


Photo by Hiram Bingham

INGENIOUS STONE-FITTING: MACHU PICCHU

A section of the ornamental wall, showing how ingeniously the joint was made with the next house wall, so as to form a brace which would prevent the house and ornamental wall from leaning apart. Notice the exquisite precision with which each block, after all these centuries in a land where earthquakes are not uncommon, fits snugly into its neighbors. There is no cement nor mortar, and yet there is scarcely a place where a pin can be driven between the stones.

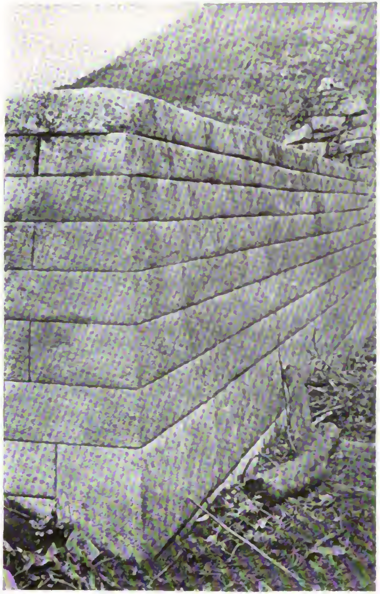


Photo by Hiram Bingham

THE FINEST WALL IN MACHU PICCHU

The exterior of the ornamental wall, the most beautiful wall in Machu Picchu. The tiers of stones gradually decrease in size toward the top of the wall. The utmost care was exercised in selecting the purest white granite, so as to produce an effect like that of the marble temples in the Old World (see page 471).

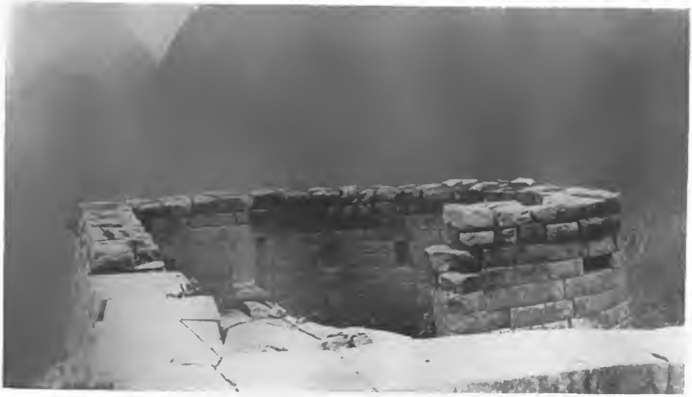


Photo by Hiram Bingham

A SIGHTLY TOWER: MACHU PICCHU

The corner of the Princess Group where the ornamental wall joins the semicircular tower is one of the most sightly spots in the city and commands a magnificent view of the great cañon. Within the tower was a sacred rock, which has been partly destroyed by fire.

WHY MACHU PICCHU IS AN ARCHEOLOGICAL TREASURE

On the other hand, Machu Picchu not only is larger and contains more edifices than any other ruin discovered in Peru (except Cuzco); it has the additional advantage of not having been known to the Spaniards, of not having been occupied by their descendants, and of not having been torn to pieces by treasure hunters seeking within the walls for the gold and silver ornaments that were not to be found in the floors.

In other words, Machu Picchu is not only more extensive than any previously discovered Inca city outside of Cuzco, but it is in a remarkably good state of preservation, and its architecture has not become confused with Spanish efforts to build churches and villas.

If the theory here propounded is correct—that Machu Picchu was the original "Tampu Tocco," from whose "three windows" set out the tribes that eventually founded Cuzco—the importance of Machu Picchu as the cradle of the later Inca race will, of course, be increased.

It is not very profitable to speculate on the habits of these ancient people until we have had more opportunity to study the finds made in the burial caves and to compare these with finds made in other parts of Peru. We know that they were masters of the art of stone-cutting.

We know that they knew how to make bronze, and that they had a considerable artistic sense, as evidenced by their workmanship. One of the bronze pins found at Machu Picchu has for a head a miniature reproduction of the head of a humming-bird, including a long, curved bill. One bronze knife is decorated with the head of a llama; another with an Indian boy, lying on his stomach, with his heels in the air, playing tug-of-war with a large fish on the end of a little bronze rope.

The workmen of Machu Picchu not only had skill, but originality and ingenuity. Their pottery is varied in form and attractive in its ornamentation. They understood how to plan great architectural and engineering works and to carry them to a satisfactory conclusion.

The soil of the terraces is extremely fertile, and the Incas utilized every square yard of available land within a radius of several miles. The two or

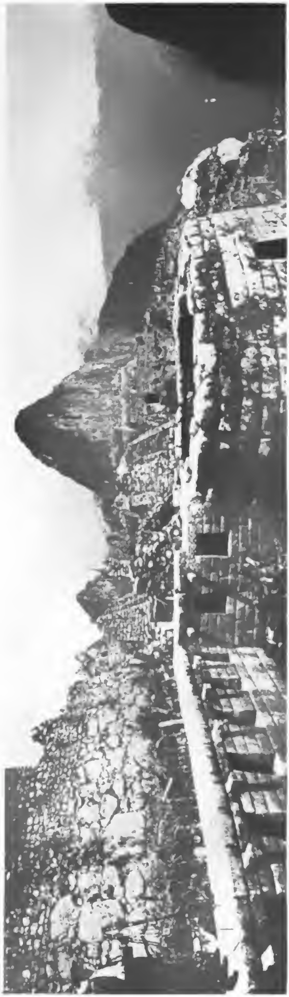


Photo by Hiram Bingham

REMARKABLE MASONRY AT MACHU PICCHU

The semicircular tower and the interior of the ornamental wall looking toward the steep gables of the King's Group and the stairway near Private Garden Group (see page 471)

three Indian families who have been living at Machu Picchu for the past four or five years have had no difficulty in raising good crops of sweet potatoes, corn, peppers, onions, tomatoes, and certain native vegetables unknown in this country. The only difficulty they have found is in keeping down the superabundant tropical vegetation, which constantly threatens to suffocate their crops.

As an instance of how rapidly this vegetation grows, terraces covered by bamboo cane which we cleared in September had to be recleared in November, when most of these pictures were taken. In the intervening two months some of the cane had attained a height of five feet.

It is my hope to prepare a special monograph on Machu Picchu for publication by the National Geographic Society.

II

DISCOVERY OF THE "CUZCO BONES" IN 1911

Another discovery made in 1911 was of the so-called Cuzco bones. The age of certain human and other bones found interstratified with glacial gravel near Cuzco was provisionally estimated by Prof. Isaiah Bowman, the geologist of the 1911 expedition, as from 20,000 to 40,000 years. These bones were brought to New Haven and submitted for examination to Dr. George F. Eaton, osteologist of the Peabody Museum.

In describing them in an article in the *American Journal of Science* for April, 1912, he says in his conclusion: "It is clear that no proof of great antiquity can be drawn from the characters of the human skeletal parts submitted to me, agreeing, as they do, in all essential respects with the bones of a recent people. Until additional skeletal material is obtained, showing characters more primitive than those already noted, the burden of proof of great antiquity must rest on geological and paleontological evidence."

Photo by Hiram Bingham

THE PRINCESS GROUP: MACHU PICCHU

A general view of the ornamental wall and the semicircular tower, together with the second story of the adjoining house, looking toward the principal agricultural terraces and our camp in the distance (see page 471).

Such geological evidence as we had been able to collect in the limited time at our disposal was presented by Professor Bowman in a paper published at the same time. Professor Bowman had reported several years before finding evidences of man's existence in the central Andes in late Glacial or early post-Glacial times. He was led to believe that the actual remains of man found in the Cuzco basin were embedded in gravels of a still earlier date.

DETERMINING THE AGE OF THESE BONES

In his interpretation of the geological and geographical evidence he reached the conclusion that the beds belonged to a Glacial series, and that the age of the vertebrate remains might be provisionally estimated at from 20 to 40 thousand years.

But he called attention to the weakness of the case, lying in the following facts: (1) that certain of the bones could not be sharply differentiated from those of modern cattle, and (2) that it was within the limits of possibility that the bluff in which the bones were found might be faced by younger gravel, and that therefore the bones had been in gravel veneer deposited during later periods of partial valley-filling.

He experienced grave doubts as to his own conclusions, because we were only

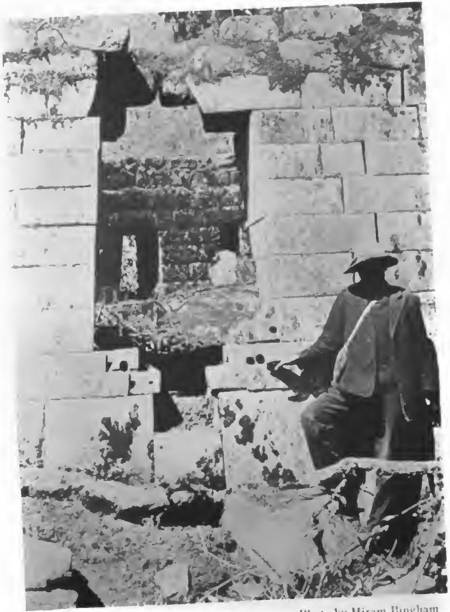


Photo by Hiram Bingham

THE SNAKE WINDOW: MACHU PICCHU

In the flat wall of the semicircular tower is a remarkable window containing holes leading to little passages in the wall through which snakes might pass to chambers left inside the wall in which they might have their nests. In the Temple of the Sun, in Cuzco, which is characterized also by having a semicircular building, holes similar to these have also been found, and it is presumable that there are inner chambers also in that wall (see pages [illegible], [illegible], and [illegible])

Photo by Hiram Bingham

WINDOW CLEANING AT MACHU PICCHU

An Indian boy trying to clean the moss off the exterior of the beautifully made semicircular tower

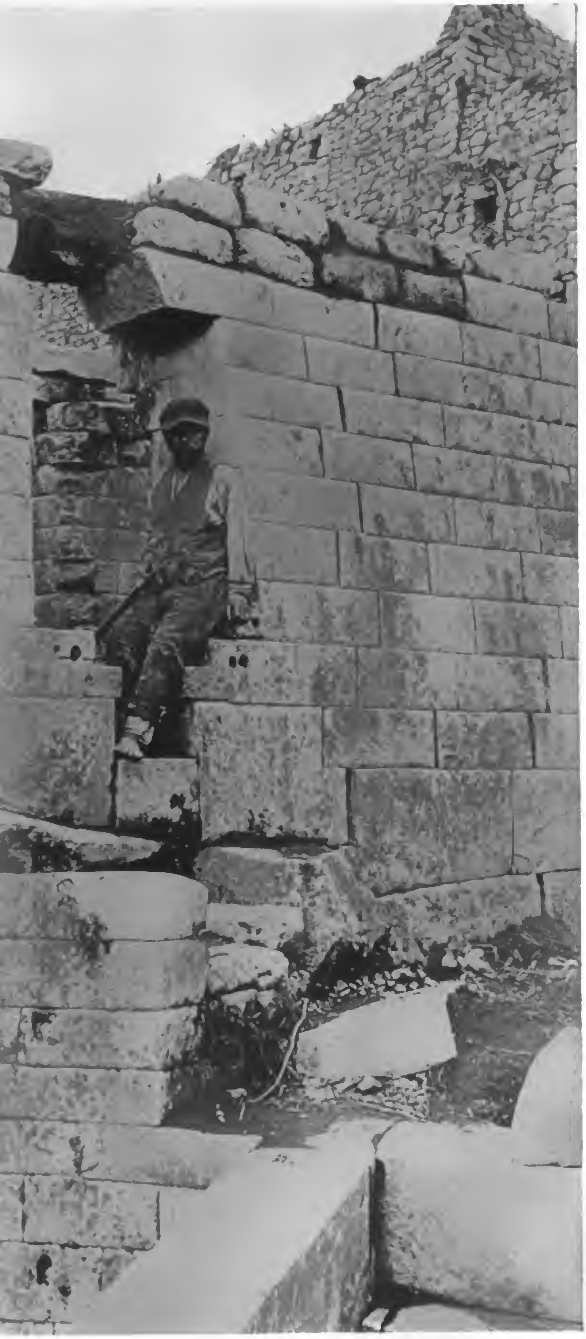


Photo by Hiram Bingham

OTHER VIEW OF THE SNAKE WINDOW

early the holes in the wall for the admission of snakes

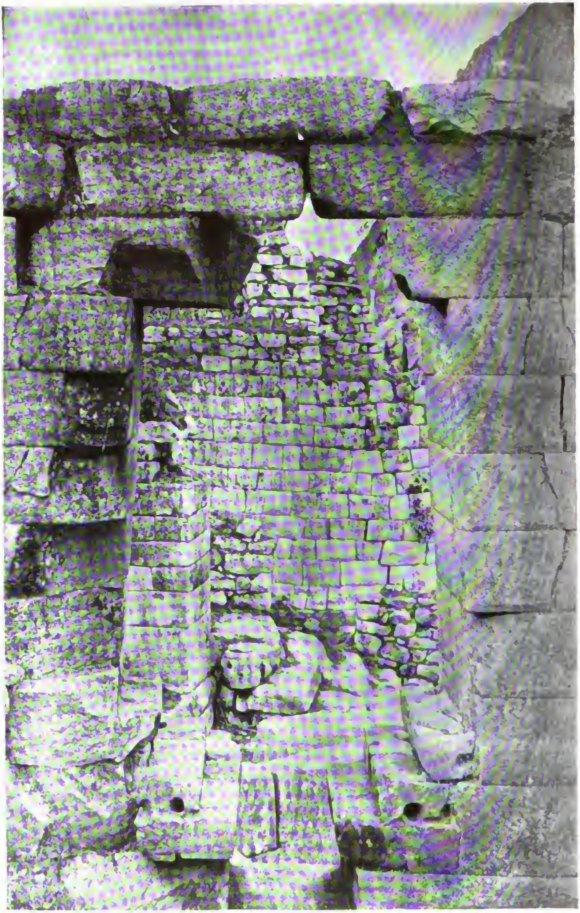


Photo by Hiram Bingham

THE SNAKE WINDOW FROM WITHIN

There were several means of exit from each snake nest, and it is possible that the priest of this temple attempted to fortell the future by noticing from which holes the snakes chanced to come out (see pages 472 and 493).

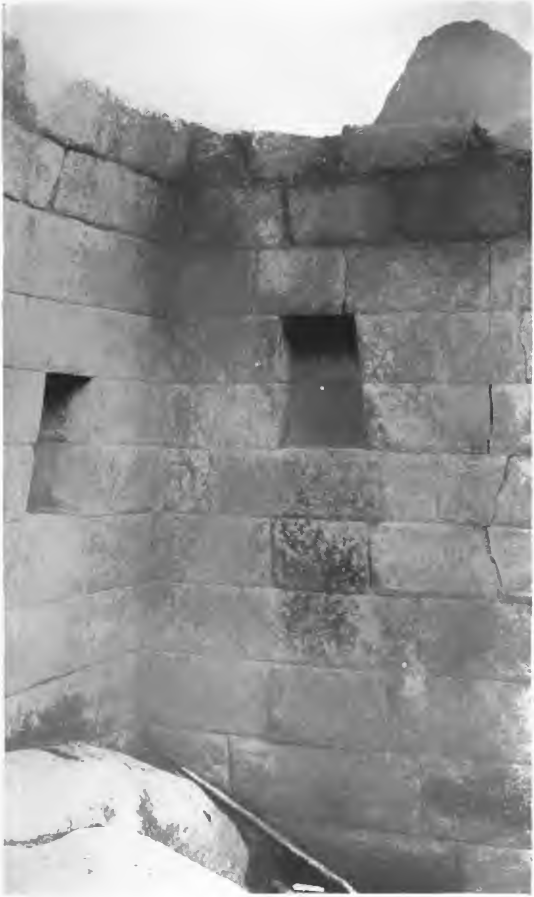


Photo by Hiram Bingham

THE INTERIOR OF THE SEMICIRCULAR TOWER NEAR THE SNAKE WINDOW

The cracks in the walls were probably caused by a great conflagration centuries ago

Photo by Hiram Bingham

THE PRINCESS GROUP: MACHU PICCHU

The semicircular tower containing the snake window and its immediate surroundings, showing the principal houses of the Princess Group on the left (see pp. 486-488), the stairway of the fountains on the right (see p. 459), and the King's Group at the extreme right (see pp. 451-455).

able to spend a very few days in Cuzco after the find was made, and concluded his report with these words:

"Further excavation is needed, for the same body of gravels may yield material that will put the conclusions upon a more solid foundation. If later studies should yield evidence in favor of the conclusion that the material belongs to the Spanish period, we shall have still the fact of interstratification as a starting point, and the conclusions based upon that fact will have almost equal interest with the conclusions here stated, as to the Glacial age of the material. Changes of such magnitude indicate a swing of the climatic pendulum but little short of remarkable."

Since further examination of the Cuzco gravel beds and a comprehensive study of their age seemed essential, this was one of the chief objects of the 1912 expedition, and it was with this particular end in view that Professor Gregory and Dr. Eaton were asked to go to Cuzco.

IDENTIFYING THE "BISONIC" BONE

Among the bones Dr. Eaton had noted three fragments of bones belonging either to cattle or bison, whose specific identification was beset with almost insuperable difficulties. After examining skeletal bison remains in various museums and comparing them with these fragments and with similar bones of a number of North American domestic cattle, he found that one of the bones, a fragmentary bovine rib, was of a form which appeared to be characteristic of the bisons and different from the forms seen in North American domestic cattle.

Dr. Eaton had said in his published report: "It cannot be denied that the material examined suggests the possibility that some species of bison is here represented, yet it would hardly be in accordance with conservative methods to differentiate bison from domestic cattle solely by characters obtained from a study of

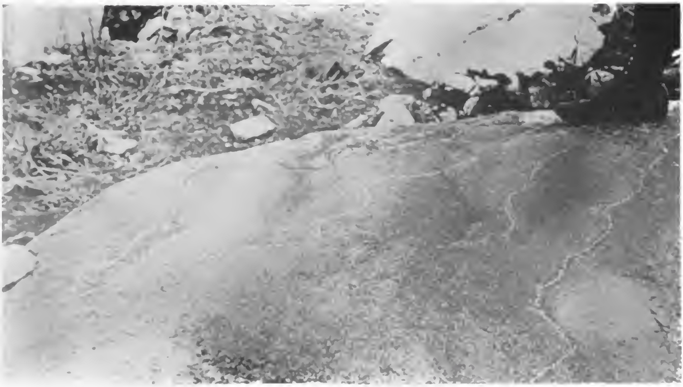


Photo by Hiram Bingham

SNAKE ROCK: MACHU PICCHU

On top of one of the boulders near the Sacred Plaza there are several snakes carved into the surface of the rock. The carving of snakes on rocks seems to have been common among prehistoric peoples all over the world (see page 472).

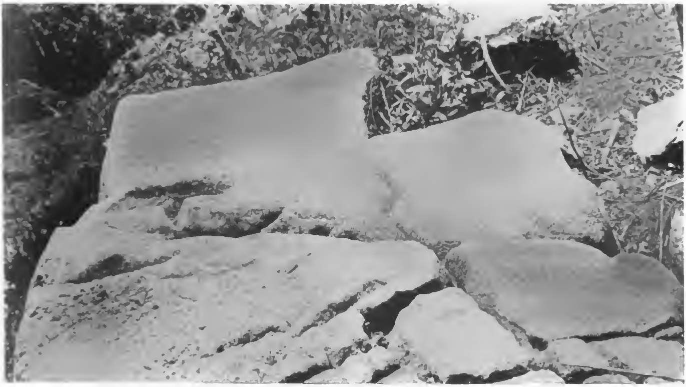


Photo by Hiram Bingham

SUN ROCK: MACHU PICCHU

On another curiously broken stone is carved a sun, several small snakes, and a few undecipherable figures

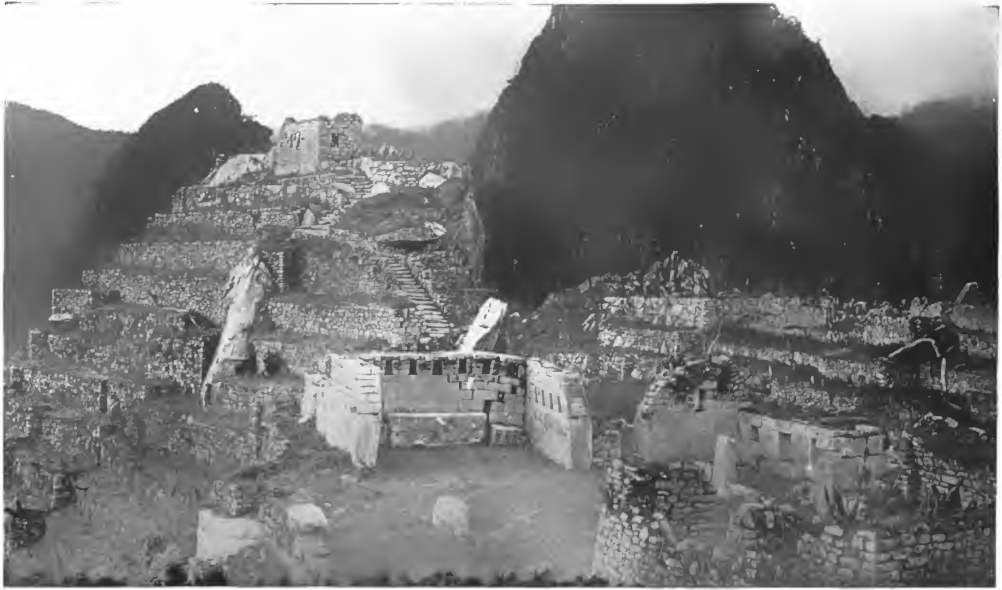


Photo by Hiram Bingham

AN ARCHITECTURAL TRIUMPH: MACHU PICCHU

A general view of the Sacred Plaza, the site of the finest structures at Machu Picchu. In the center is the Chief Temple (see pages 409, 501, 503, and 512), and at the right the Temple of the Three Windows (see pages 408, 409, 416, 417, 418, 431, 474). Above them is the Sacred Hill, on top of which is the Intihuatana stone, or sun dial (see pages 507, 509). Contrast this picture, which was taken in 1912, after months of strenuous work in cleaning the city, with the picture on the following page, which was taken in 1911.

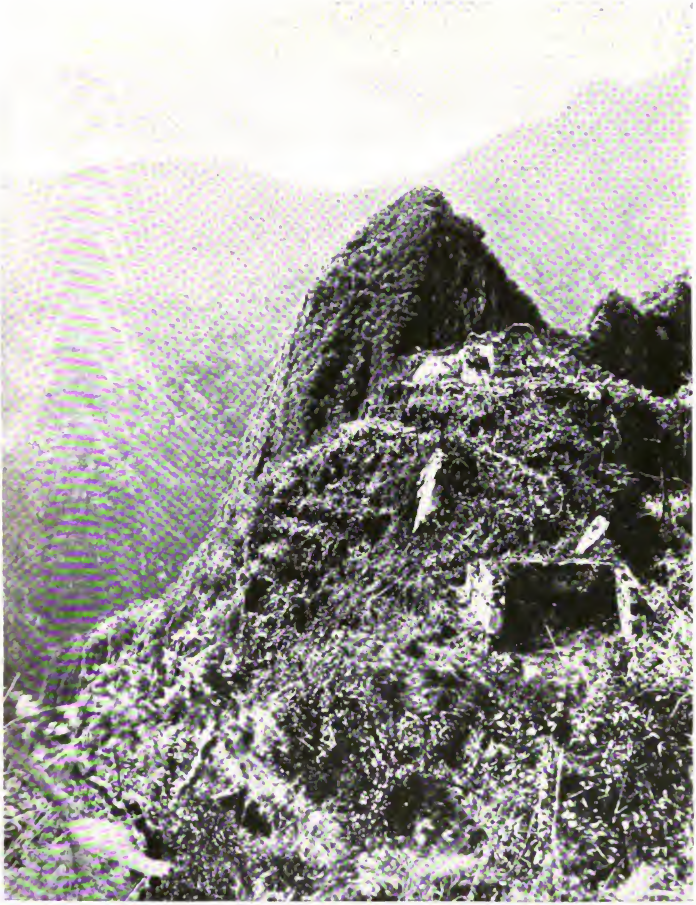


Photo by H. L. Tucker

A PICTURE OF THE SAME PART OF THE CITY OF MACHU PICCHU AS SHOWN IN THE PRECEDING ILLUSTRATION, BUT PHOTOGRAPHED THE YEAR BEFORE

The comparison of these two pictures shows in a very striking manner the immense amount of labor and energy expended by members of the expedition in 1912 in clearing the ruins, so that the members of the National Geographic Society could obtain a good conception of the city (see also page 449).

Photo by Hiram Bingham

A CORNER OF THE THREE-WINDOWED TEMPLE

In the walls of the temples on the Sacred Plaza are several extraordinarily large granite blocks. In the hole in the upper left-hand corner of the picture rested one end of the beam which supported the roof on the west side of the Temple of the Three Windows. The women are wives of our workmen. The one on the right was wearing a green skirt with a red waist and blue stripes; the one on the left had on a blue skirt and a red blouse with black dots.

the first ribs of a small number ot individuals."

Consequently his first interest on reaching Cuzco was to secure specimen ribs of Cuzco domestic cattle. The very first one that we were able to procure from a local butcher shop told a new story.

Dr. Eaton reports as follows: "The plans for osteological work included the dissection of the carcasses of beef animals reared in the high altitudes of the province of Cuzco. This study revealed the fact that, under the life conditions prevailing in this part of the Andes, and possibly due to the increased action of the respiratory muscles in the rarefied air, domestic cattle can develop first ribs of 'bisonic' form.

There is, therefore, no reason for supposing that the bovine rib found with the human bones in the Ayahuaycco Quebrada in 1911 belongs to some species of bison, and any theory attributing great antiquity to the 'Cuzco man' based on such a supposition is untenable.

VALUABLE SPECIMENS EXCAVATED IN CUZCO VALLEY

"Systematic search in the Cuzco Valley for ethnological and paleontological material was carried on. Laborers were employed and excavations made in the terraces beneath the walls of the Sacsahuaman fortress; in the gardens of the Inca palace near the fortress and among the ruins of the near-by hill called Picchu. Several ancient graves on the hills overlooking the village of San Sebastian were explored. Much valuable material was collected, including human skeletons, belonging presumably to both the historic and prehistoric periods, together with the bones of contemporaneous lower animals, implements and ornaments of stone, bone, metal and shell, and pottery. The so-called "ash deposits" of the city were examined, and specimens were obtained that will probably show that these deposits do not go back of the Hispanic period.

"Two days were spent making a reconnaissance of fossil beds near Ayusbamba [near Paruro], about 30 miles southwest from Cuzco, and the results of this brief visit gave such promise that later in the season another trip was made to this interesting locality in company with the geologist and two topographers. Although the locality had already been visited several times by amateur collecting parties, it was still possible to obtain a considerable amount of vertebrate material that will probably yield very satisfactory results."

GEOLOGICAL INVESTIGATIONS

The geological examination of the Cuzco Valley undertaken by Professor

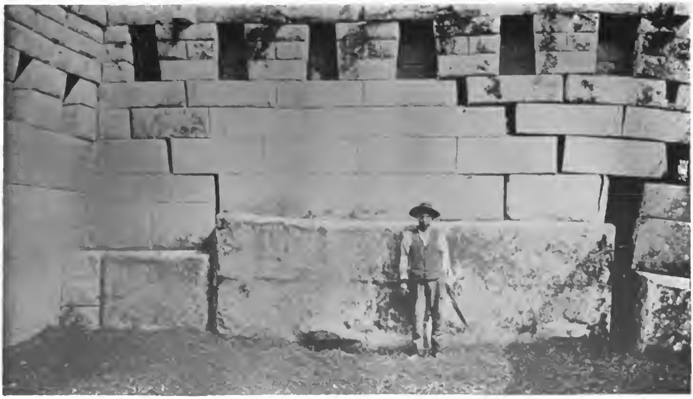


Photo by Hiram Bingham

THE ALTAR OF THE CHIEF TEMPLE OF MACHU PICCHU

The interior of the Chief Temple on the Sacred Plaza, showing the cracking caused by the settling of the east wall. Notice the care with which the size of the stones is made to decrease gradually in each ascending tier. The main altar stone is 14 feet in length and a little over 5 feet in height.

Gregory consisted, in the first place, of a study of the gravel deposits near Cuzco and the relation in age and position of these gravels to the remains of men and other animals discovered in them, both on the present and on the former expedition. In a preliminary summary of his investigations Professor Gregory says: "The gravels were found to be portions of an extensive alluvial fan of Glacial age, but the human relics embedded in them are probably of much later date." These deposits will be described fully in a paper on the Cuzco gravels to be published in the near future.

In regard to the other parts of his work, Professor Gregory reports as follows:

It consisted of "an examination of the structure, stratigraphy, and physiography of the Cuzco Valley with a view to securing the data for a geologic map of the area tributary to the Huatanay River. The region was found to consist chiefly of sedimentary rocks of pre-Tertiary, Tertiary, and Pleistocene age. Basic igneous intrusions are present and five intrusive masses of andesite (?) are represented by outcrops. During Glacial times a lake occupied the upper part of the valley. Fossils from Mesozoic and recent strata are sufficient to determine the relations of at least part of the formations. The results of the geologic survey, including stratigraphic and petrographic maps, are to be embodied in a report dealing with the area as a whole."

Professor Gregory also made a survey of Ayusbamba, on the Apurimac River, the locality from which fossil vertebrates were collected by Dr. Eaton. The strata at Ayusbamba are clays and sands deposited in an ancient lake perched high above the valley floors at an altitude of over 11,000 feet.

The Island of the Sun, in Lake Titicaca, Bolivia, was studied by both Professor Gregory and Assistant Topographer Heald, with reference to its coal deposits. A collection of carboniferous fossils was secured.

THE TROUBLES OF A CARTOGRAPHER

Owing to a most unfortunate misunderstanding, occasioned by the difficulty of getting messages transmitted in an un-

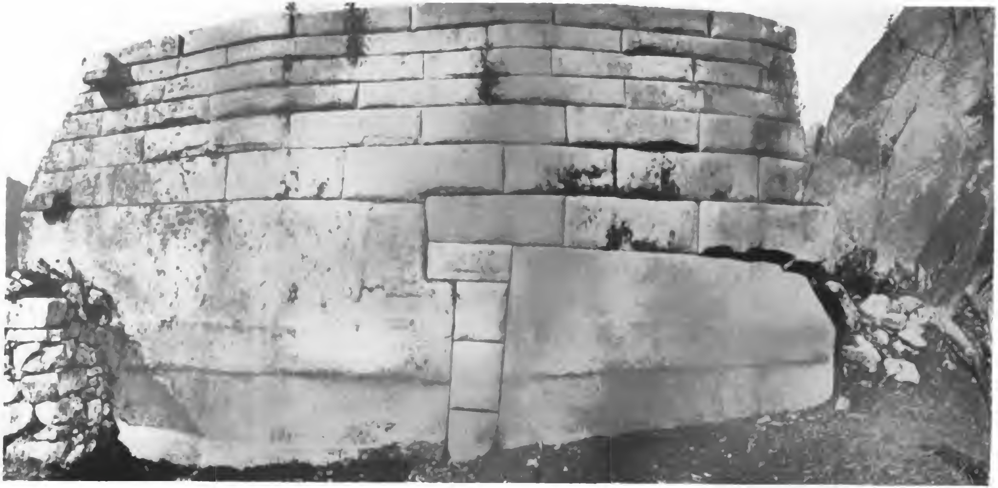


Photo by Hiram Bingham

A MASTERPIECE OF PREHISTORIC CONSTRUCTION

The east wall of the Chief Temple on the Sacred Plaza. The relative size of the large stone in the left-hand corner, which is 13½ feet in length and nearly 8 feet in height, may be gathered better from the next picture

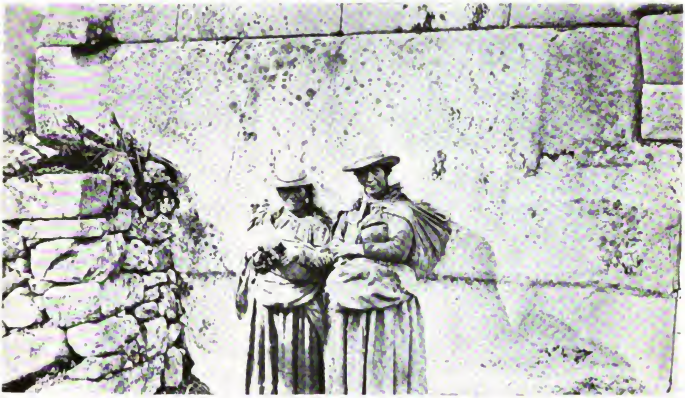


Photo by Hiram Bingham

TYPICAL INDIAN WOMEN AT MACHU PICCHU

The largest stone in the east wall of the Chief Temple on the Sacred Plaza and the wives of two workmen

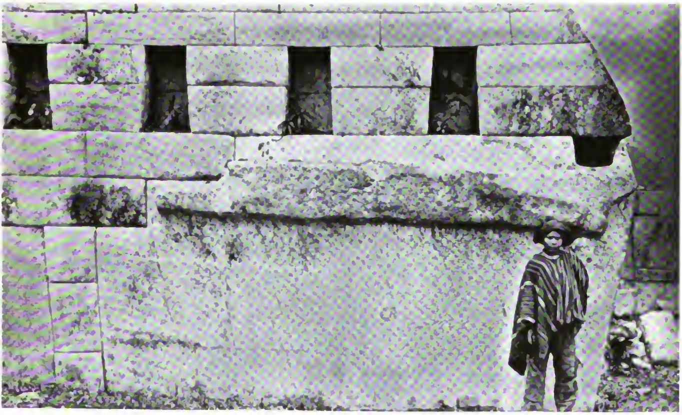


Photo by Hiram Bingham

THE HEAVIEST STONE BLOCK IN A MACHU PICCHU WALL

The interior face of the same stone and the ornamental niches in the east wall of the Chief Temple. The hole in the upper right-hand corner was undoubtedly for the admission of the beam which supported the roof of this temple.

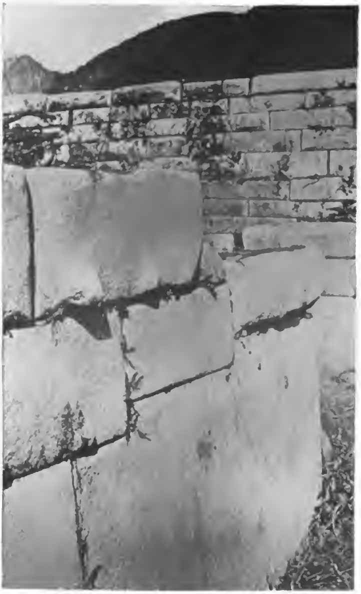


Photo by Hiram Bingham

AN INTERESTING CORNER: MACHU PICCHU

Back of the Chief Temple and adjoining it are the ruins of a small house probably occupied by the High Priest. The picture shows a portion of the exterior of its western wall. Part of this wall is made of a single stone, which is cut into 32 angles and corners.

inhabited region, quite a little of Mr. Bumstead's work was unintentionally destroyed. It was necessary for him to leave the Cuzco Basin and work on the Andine cross-section before the Cuzco map was completed. This was occasioned by the rapid approach of the rainy season. Arrangements were made with the chief engineer of the Southern railways to have the map photographed. The permanent contour lines were inked in, but all streams, roads, ruins, terraces, plane-table locations, and many geographical names and all elevations were left on the sheet in pencil.

The photographer thought that the map looked rather badly with all these pencil-marks on it, and a telegram was sent to the director, requesting permission to erase all pencil-marks. This telegram was received *six weeks* later, on my return from a difficult journey into the interior.

It was then too late to save Mr. Bumstead's work, for the photographer, impatient at the delay, and not receiving permission to clean the map, had gone ahead on his own responsibility and erased what a month of careful field-work could not replace. As Mr. Bumstead says in his report:

". . . Only one who has seen his patient and painstaking work destroyed can imagine my feelings when I returned to Cuzco within about a week of the time when the new Peruvian government said we must stop all our work—weary and almost discouraged from a trip that had ended in profitless waiting in a leaky tent for a cold rain to stop and permit the work to proceed through a region where the rainy season had set in in good earnest—only to find that all the above mentoined penciling on the Cuzco Valley map had been completely and absolutely lost."

HAMPERED FOR LACK OF TIME

The new Peruvian government had stipulated in their decree that all the work of excavating *and exploring* must cease on the first of December, and the local authorities were directed to see to it that this order was carried out. In the limited time that remained it was impossible to finish the map of the Cuzco Valley as carefully as it had been begun.

It was decided, however, that it would be much better to map the area needed by the geologist as well as it could be done before the day set by the government for the conclusion of our work. Accordingly, great pains have been taken to show the true character of the topography.

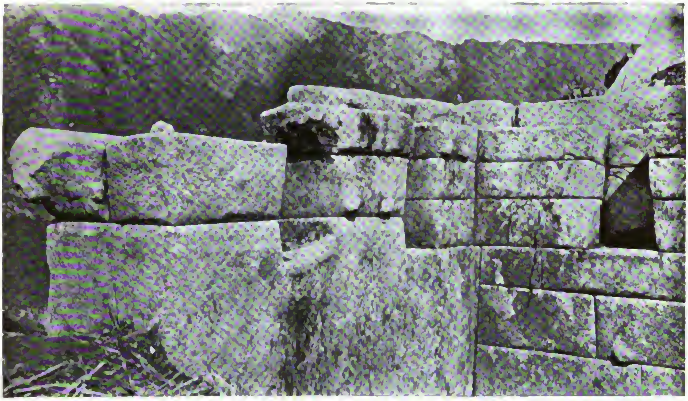


Photo by Hiram Bingham

THE HIGH PRIEST'S HOUSE: MACHU PICCHU

This picture of the interior of the priest's house gives a better idea of the stone of the 32 angles. Not only were portions of two niches cut out of this stone, but in a spirit of freakish ingenuity the builders carried a small portion of the stone around the corner, so that a part of the corner itself is in this extraordinary block.

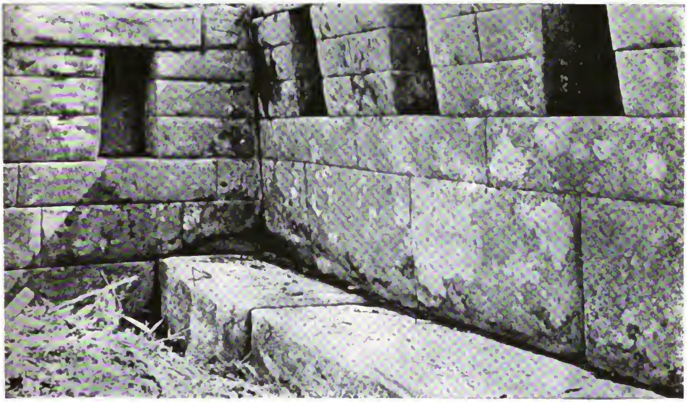


Photo by Hiram Bingham

THE HIGH PRIEST'S COUCH

Another view of the interior of the priest's house, showing the long bench, or platform, which was probably used as a couch. Notice the care with which the stones were selected, cut, and symmetrically arranged.

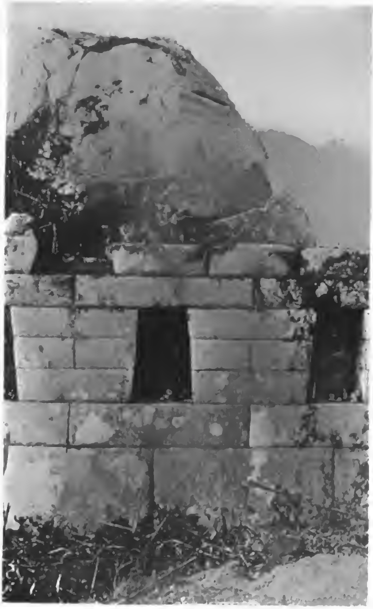


Photo by Hiram Bingham

AN EXAMPLE OF REMARKABLY SYMMETRICAL MASONRY

Another view of the interior of the priest's house and the sacred rock back of it. Note the steps cut in the rock to enable the priest to get on top of it and salute the rising sun are just visible in the picture.

The scale of the Cuzco Valley map is 1 inch to the mile, and the contour interval is 100 feet. The map covers in all 174 square miles. It includes nearly all the territory that drains into the valley of the River Huatanay, which rises in the mountains back of Cuzco, flows through the city and under part of it between walls constructed by the Incas, crosses the bed of an ancient lake, and finally joins the upper waters of the Urubamba, called at this point the Vilcanota or Vilcamayu.

Peruvian rivers have a habit of changing their names every few miles, and this particular river is no exception. It is called at various times the Vilcanota, the Vilcamayu, the Rio Grande, the Urubamba, the Santa Ana, and finally unites with other rivers to form the Ucayali, one of the great branches of the Amazon.

Mr. Bumstead's map of Cuzco Valley shows the elevations and relative positions of Cuzco, the great cyclopean fortress of Sacsahuaman, and the four historic roads leading out of the ancient Inca capital. It also aims to bring out clearly the chief topographic and physiographic features that are characteristic of the locality. It will be used by Professor Gregory and Dr. Eaton as a basis for their reports on the geology and osteology of this region. If extensive scientific archeological work is ever permitted in this region, this map will be of great service in determining the geographic influences in the location of the ruins.

III

MAP-WORK OF THE EXPEDITION

The map-work was under the direction of Mr. Albert H. Bumstead, for nine years a topographic engineer in the United States Geological Survey. Mr. Bumstead's work was seriously handicapped by the fact that the seasons seem to be changing in Peru, and an unexpectedly large amount of rain was encountered in what is technically known as the "dry season." Furthermore, the difficulties of making maps in a lofty plateau, where, for example, the bottom of the Cuzco Valley is more than twice as high as the top of Mount Washington, can hardly be appreciated except by those who have tried to do field-work at similar elevations.

In 1911, owing to lack of preliminary reconnaissance and excessively hard local conditions, the topographer of the expedition had been unable to do anything on the most difficult part of the cross-section map. This work was now undertaken by

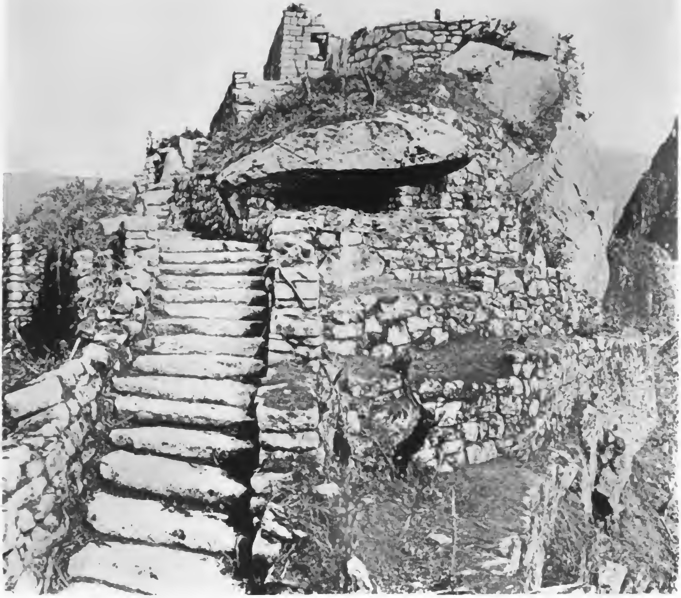


Photo by Hiram Bingham

A WELL-BUILT STAIRWAY: MACHU PICCHU

Near the priest's house is the most carefully constructed stairway at Machu Picchu, each one of whose steps was originally a single block of granite. This leads from the Sacred Plaza up to the top of the Sacred Hill (see pages 472, 508, and 509).

Chief Topographer Bumstead and Assistants Hardy and Little.

A route map was completed along a rarely used trail from Abancay, the capital of the department of Apurimac, across the Apurimac Valley via Pasaje to Lucma, this being the portion of the map not completed in 1911. Mr. Bumstead's map is on a scale of 1 inch to the mile, with a contour interval of 200 feet. It covers approximately 500 square miles. Frequent latitude and azimuth observations were made all along the route, and an occultation of a first-magnitude star was observed in connection with time sights on the moon and Jupiter immediately afterwards (see page 388).

The route covered by this map is about 100 miles in length and passes through a great variety of very heavy mountainous country. The elevations here range from about 4,000 feet up to more than 19,000. The most important features represented on this map are the glaciers of that part of the Vilcabamba Cordillera between Choquetira, Arma, and Lucma. A large part of this country was under glaciation at no very distant date, and great pains were taken to bring out the glacial forms.

This map will be of great value in giving proper understanding of the physiography of the central Andes, and will be published in connection with Profes-

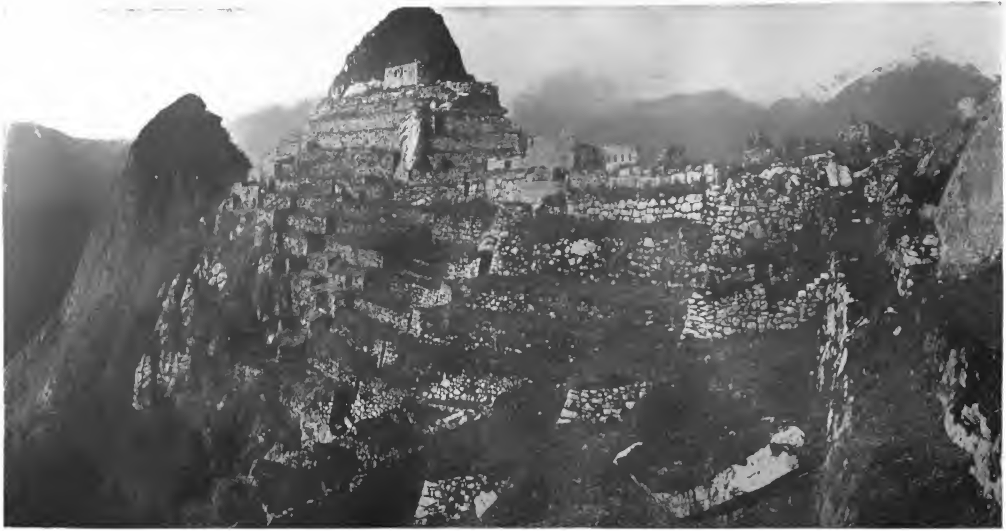


Photo by Hiram Bingham

INTIHUATANA HILL AND THE TERRACES WEST OF THE SACRED PLAZA

On the left may be seen some of the precipices which defended Machu Picchu from attack. In the foreground are a group of the terraces where the ancient inhabitants raised their crops. Rising above these is Intihuatana Hill, crowned by its little temple. Just to the left of the temple may be seen the Sun Dial Rock. To the right of the hill is the Chief Temple and the Sacred Plaza. By comparing this with the view on page 409, the effects of the clearing in 1912 are brought out very clearly.

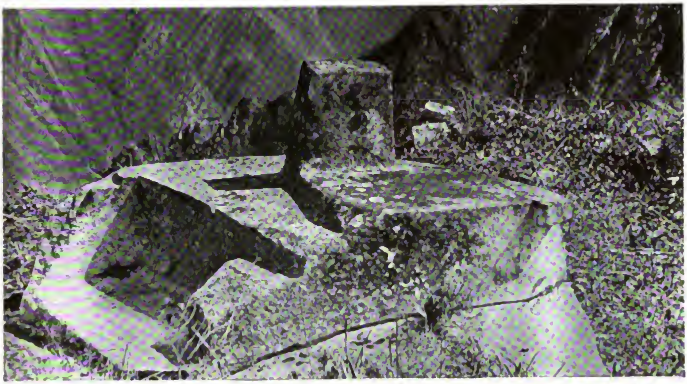


Photo by Hiram Bingham

THE SUN DIAL: MACHU PICCHU

On top of the sacred hill is a curiously carved stone called an *Intihuatana* stone, or sun dial, or sun circle. *"Inti"* means "sun," and *"huatana"* a "rope," in Quichua, the language of the Incas. *Intihuatana* stones are found also in Cuzco and in Pisac and Ollantaytambo (see pages 472 and 507).

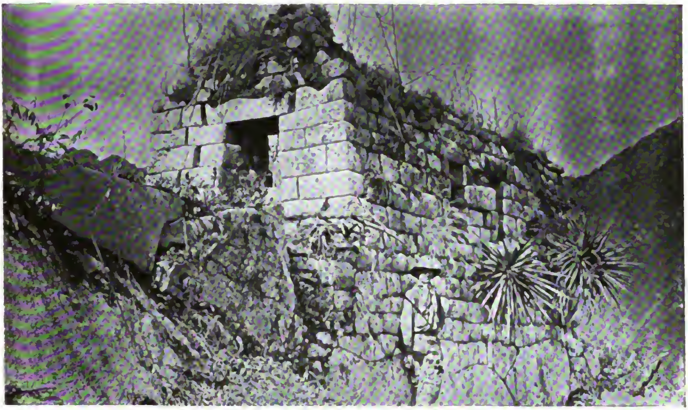


Photo by Hiram Bingham

A GEM OF INCA ARCHITECTURE

The little temple on top of the sacred hill near the Intihuatana stone

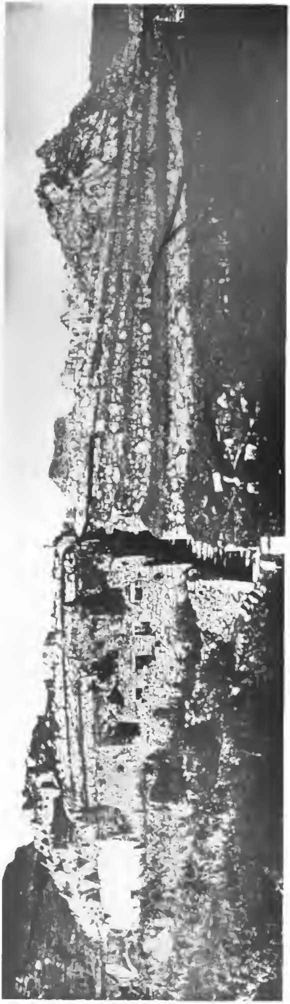


Photo by Hiram Bingham

THE WEST SIDE OF MACHU PICCHU

General view of Machu Picchu, showing (reading from right to left) the sacred hill, the Temple of the Three Windows and the Sacred Plaza, the principal cross street in the city and one of the finest stairways, a group of houses characterized by having four doors in the principal house, the beautiful outer wall of the King's Group, and finally the semicircular tower of the Princess Group.

sor Bowman's account of the geological cross-section made in 1911.

In describing his work on this map, Mr. Bumstead says:

"With such meager control as time and bad weather permitted, I endeavored to make a map of as wide a strip of country as possible, that would first of all convey the same impression of the topography upon the person who should use the map as I had at the time that I made it; that is, I wanted my map to accurately describe the character of each mountain and valley shown. This I kept ever in mind, and frequently reached out five or six miles with estimated distances to sketch features as I saw them, knowing that even though their positions and elevations were far from right, the picture brought to mind by the use of the map would be far better than nothing at all.

"In the main, however, the map is fairly well controlled, and in the snow-and-glacier-covered mountains around Choquetira and Arma I took very great pains not only to show a good picture of this wonderful region, but to make an accurate and dependable topographic map as well, and I got good locations and elevations on all the peaks and many other points besides.

"In making this map we followed the route of Professor Bowman in 1911. He expected the work to be done in 21 days. I think it could have been done in 30 days of good weather, and done even better than I did it, though I took three months, as I was hampered by fog and rain and snow almost continually from the time we left Abancay. It was aggravating in the extreme to catch glimpses of the wonderful scenery as the clouds would lift or settle and then have the peaks disappear from view before they could be located and sketched."

It was hoped that Mr. Bumstead would be able to locate and get the elevation of Mount Salcantay while on this trip, but it remained cloudy during the entire time.

Photo by Hiram Bingham

THE NORTH SIDE OF MACHU PICCHU

General view of the north and east side of Machu Picchu, showing (reading from left to right) the Sacred Plaza, the sacred hill, the inner garden terraces, the peak called Huayna Picchu, the Private Garden Group, and a carved stone which commands a magnificent view of the Urubamba Cañon. A comparison of this picture with that on page 424 shows the tremendous work of clearing that the expedition accomplished.

IV

THE LAST INCA CAPITAL—VITCOS

A map of the vicinity of the last Inca capital of Vitcos, including the present-day villages of Puquiura and Vilcabamba, was made on a scale of 3 inches = 1 mile, with 100-foot contours.

This country is of great interest to students of historical geography. It is in the midst of a wonderful labyrinth of tropical valleys and glacier-clad mountains. Readers of Prescott's "Conquest of Peru," a book whose charm is as fresh today as it ever was, will remember that Pizarro selected Manco, a son of a former Inca, as the most available figurehead in whose name the Spaniards could govern Peru. He was crowned Inca in 1534, but he had too much good red blood in his veins to submit to Spanish tutelage, so he escaped, raised an army of faithful Indians, besieged Cuzco unsuccessfully, retreated to Ollantaytambo, and thence made good his escape into the fastnesses of this Andean labyrinth.

He found it easy to defend himself in this practically impregnable region called Vilcabamba, and he was able occasionally to make raids on Spanish caravans bound from Cuzco to Lima. A large part of the road over which he must have passed in making these raids was mapped for the first time by Mr. Bumstead, and is included in the Andean cross-section map referred to above (page 507).

The young Inca Manco lived at a place called Vitcos for 10 years. Here he actually received and entertained Spanish refugees. One of these, a hot-headed fellow, fell out with the Inca over a game

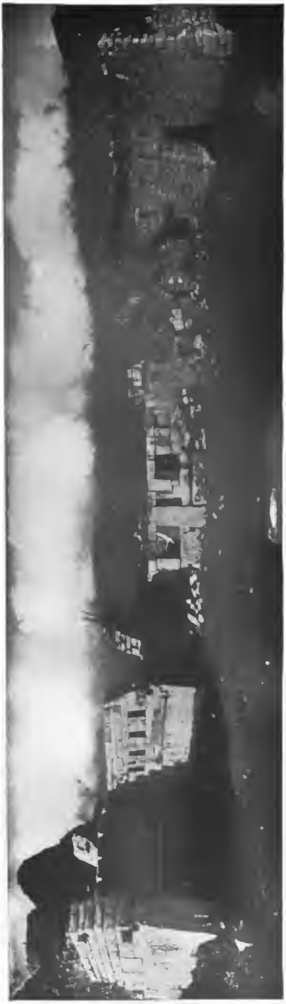


Photo by Hiram Bingham

THE SACRED PLAZA: MACHU PICCHU

This general view of the Sacred Plaza was taken at the conclusion of the season's work after the excavations had been finished and the ground releveled; showing the efforts that were made to leave everything in as good, if not better, condition than when we found it. The structure at the right, built in an entirely different style from the others, was probably originally covered with stucco, so that the general appearance of this plaza was anciently of a more symmetrical appearance than it is at present. In the floor of this building were found several bottle-shaped graves that had been opened many years previously. The structure at the left, the Chief Temple, is unquestionably one of the most remarkable architectural achievements of the Incas. In the center are ruins of what we have called the Temple of the Three Windows. As the windows are far too large for comfort in this cold climate, and are placed in a most conspicuous position, the conclusion reached is that they were symbolical. We believe they are connected with the tradition of the origin of the Incas (see pages 410, 414, 431, 489).

of bowls (some writers say it was chess), and in the quarrel that ensued the Inca was killed.

Two of his sons ruled in turn in his stead, so that for 35 years the country about Vitcos was governed by the Incas, and was all that was left to them of their magnificent South American empire.

PREVIOUS SEARCHES FOR VITCOS

When the famous Peruvian geographer, Raimondi, visited this region about the middle of the 19th century, no one seems to have thought of telling him that there were any ruins hereabouts. He knew that the young Inca Manco had established himself somewhere in this region, and he also knew that interesting ruins had been found at Choqquequirau, and described by the French explorer, Sartiges, in the *Revue des Deux Mondes* in 1851, so Raimondi concluded that the ruins of Choqquequirau must be those of the last Inca's long-lost capital.

Raimondi's proofs of the coincidence of Choqquequirau and the Inca capital are very vague, but as long as the only ruins reported from this region were those of Choqquequirau, nearly all the Peruvian writers, including the eminent geographer, Paz-Soldan, fell in with the idea that this was the refuge of Manco.

The word "Choqquequirau" means "cradle of gold," and this lent color to the story in the ancient chronicles that the Inca

Apart from the Sacred Plaza, this is the center of the finest stonework in Machu Picchu. On the right is the beautiful group that is characterized by having the steepest gables and the finest monolithic lintels. In the center is a portion of the longest stairway, the one in which fountains are introduced at various stages. On the extreme left is a portion of the semicircular tower and the window of the snakes.

Manco had carried with him from Cuzco great quantities of gold utensils for use in his new capital.

Personally I did not feel so sure that the case was proven. The ruins did not seem fine enough for the Inca's residence. Consequently I was very glad that it was possible in 1911 to carry an exploring expedition into the Vilcabamba Valley, and still more delighted when we found interesting ruins at a place called Rosaspata.

Near Rosaspata was an extraordinary monolith, called "Ñusta Espana." By reference to the Spanish chroniclers, we found that it was recorded that near Vitcos, the last Inca capital, was a temple of the Sun, in which was a white rock over a spring of water. Furthermore, that Vitcos was on top of a high mountain, from which a large part of the surrounding region could be seen, and, moreover, that in the palace of Vitcos the doors, both ordinary and principal, were of white marble, beautifully carved.

WHY THE ÑUSTA ESPANA IS THE KEY TO THE IDENTIFICATION OF VITCOS

All of these points of description fitted the Rosaspata locality. Within half a mile of Rosaspata are the ruins of an ancient building which might have been the temple of the Sun, and in which is found a huge white rock, overhanging a spring of water (see pictures, pages 550-554). The ruins of Rosaspata are on top of a conspicuously high hill, from which the view in all directions is fine.

Finally the ruins of Rosaspata, unlike those of Machu Picchu and Choqquequirau, are noticeable because there are two kinds of doors, ordinary and principal ones, and that the door-posts are made of stones carefully carved out of white granite. (Strictly speaking, there is no *marble* in

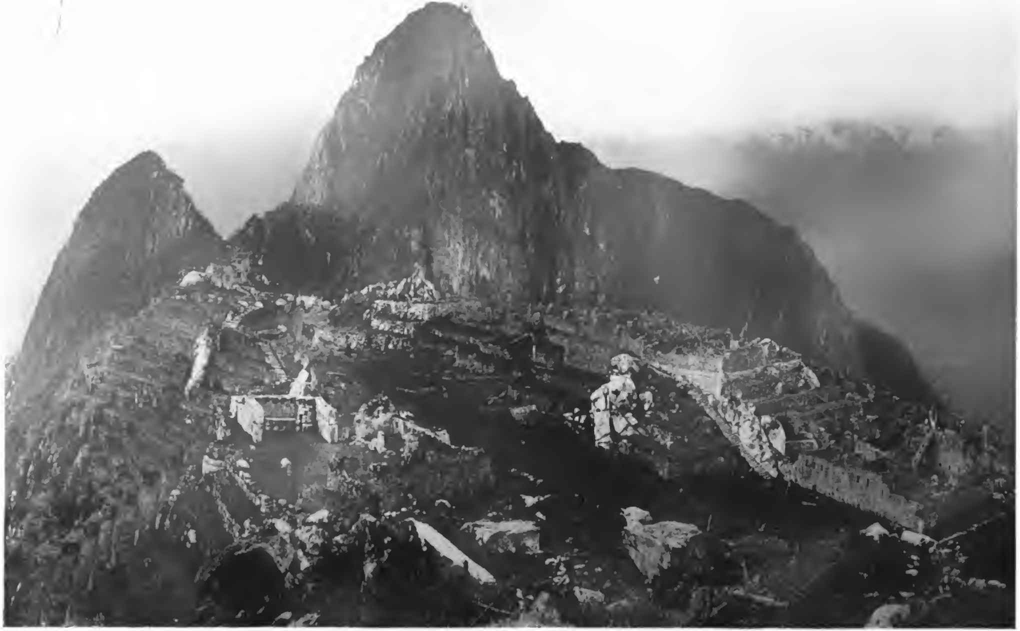


Photo by Hiram Bingham

THIS PICTURE GIVES A GENERAL VIEW OF ABOUT ONE-HALF OF THE CITY OF MACHU PICCHU

On the left are the western agricultural terraces. Above them is the Sacred Plaza, with the Chief Temple and the three-windowed temple to the right of it. Above these and connected with them by the finest stairway in Machu Picchu is the sacred hill, on which is located the Intihuatana, or sun dial stone. In the central picture in the immediate foreground are the rough boulders near which we found most of the little bronze pins and artifacts. Above them are the terraced gardens and a thatched hut built by the modern Indians. Above this in turn is one of the most densely crowded portions of the city, while to the right above the long stairway is the group called the Private Garden Group, and below it, on the extreme right, the group characterized by greatest ingenuity in its stonework. The beautiful peak of Huayna Picchu overshadows the city like a sentinel. On its summit were found a few rough caves whence guards could give warning of approaching danger.

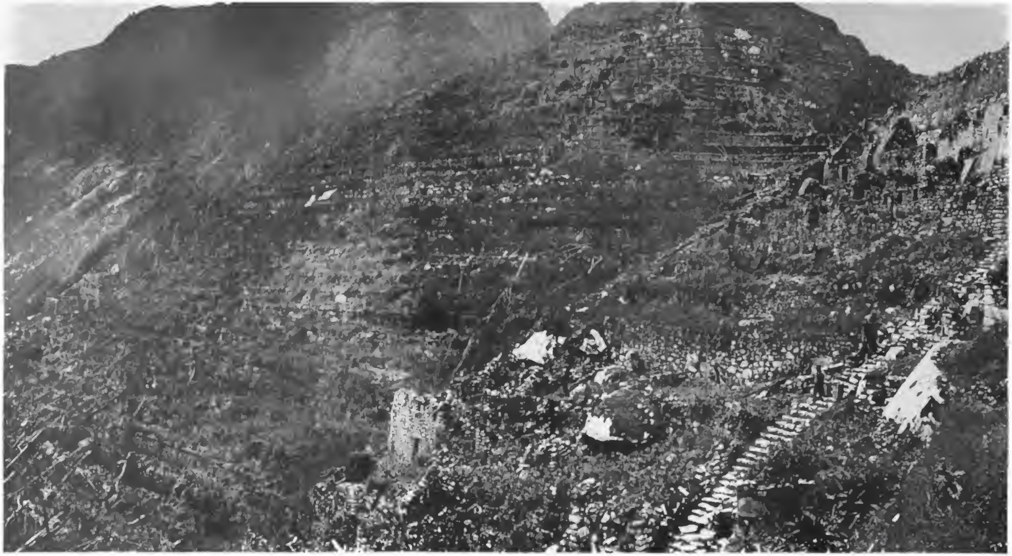


Photo by Hiram Bingham

THE AGRICULTURAL TERRACES WHERE THE ANCIENT INHABITANTS OF MACHU PICCHU RAISED THEIR CROPS

High up on the right may be seen part of the Upper City and the buildings of the Princess Group. Just beyond these is the inner city wall and the dry moat, which comes down the hill just outside the building in the lower center of the picture. Above this, in the center of the terraces, may be seen the archeological camp, and to the left the group called the *outer barracks*, outside of which runs the outer wall of the defenses of Machu Picchu. On the slopes in the distance are the ruins of ancient terraces that have been carried away by recent landslides. Every available foot of the country was once under cultivation.

Photo by G. F. Eaton

DIRECTOR BINGHAM AT WORK

Taking pictures under difficulties on top of a wall hidden in one of the uncleared portions of the city of Machu Picchu

Photo by E. C. Erdis

THE DIRECTOR AT REST: MACHU PICCHU CAMP

The main tent in the camp at Machu Picchu and the Director at the completion of the season's work

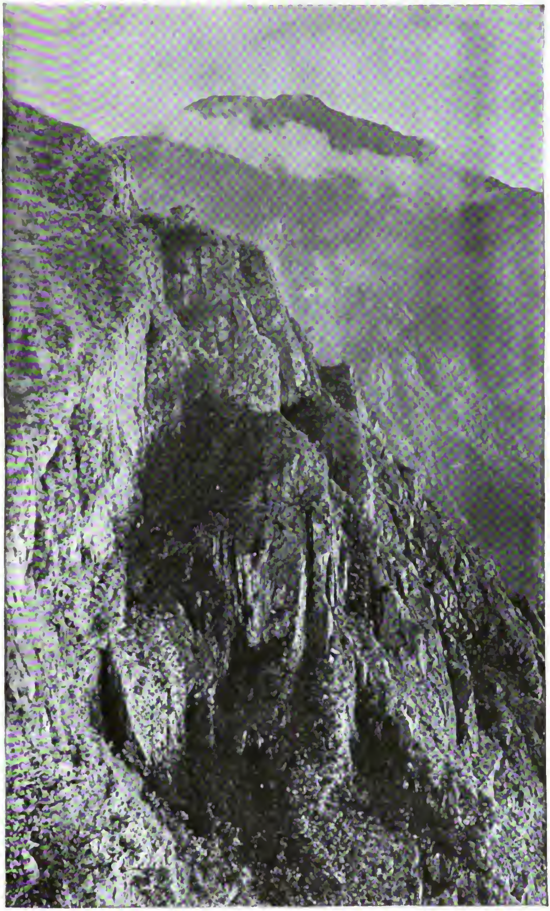


Photo by Hiram Bingham

THE WESTERN PRECIPICES: MACHU PICCHU

Forest trees growing wherever there is a foothold have usually been found in this region to cover ancient agricultural terraces, and they probably do in the cases shown in this picture. The western trail to Machu Picchu climbs out of the cañon in the lower right-hand corner and winds up the precipice until it passes over the shoulder near the top of the precipice.

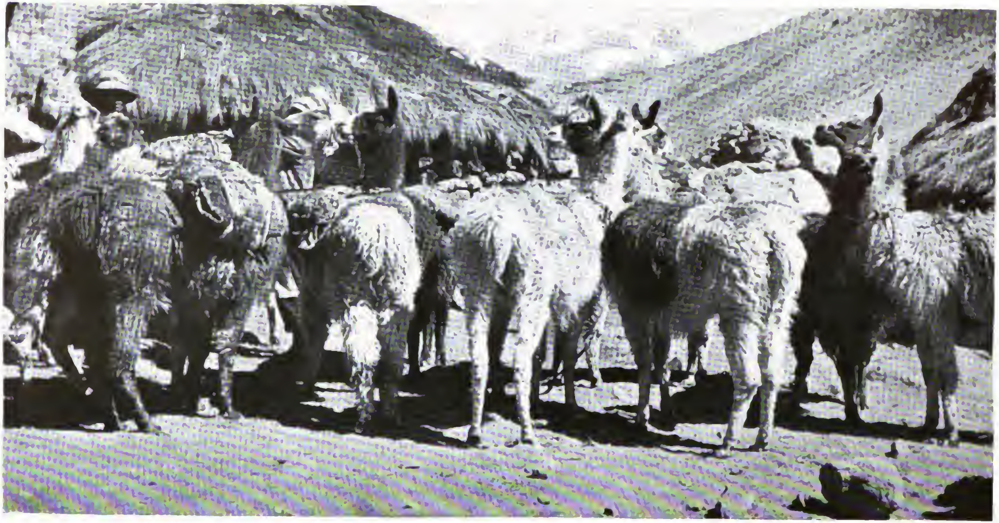


Photo by H. L. Tucker

WHERE THE POTTERY COMES FROM

The potter's family often lives in a lofty and remote mountain valley. In the present case it was at an altitude greater than that of the top of Pike's Peak. Here the women make the pots, the men take care of the llamas, and when the pots have been baked and are ready for shipment, a number of sturdy llamas are selected from the herds, laden with the pottery, which has been carefully packed in dried grass, and driven off to the nearest market town.

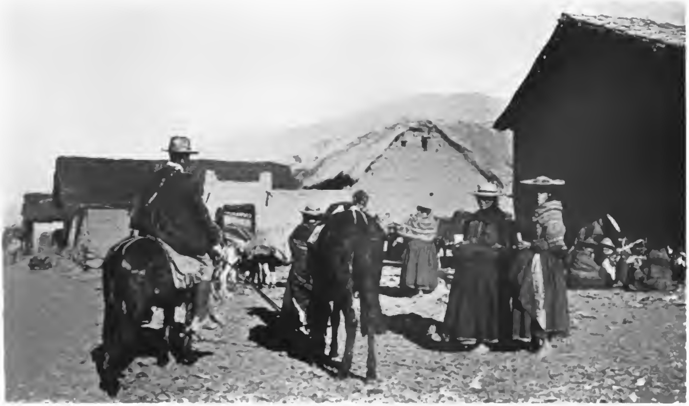


Photo by Hiram Bingham

THE PLAZA OF SAYLLA: CUZCO VALLEY

In the Cuzco Valley, as well as on all the roads in the uplands of Peru, whenever an Indian passes through a village he stops to get a drink of *chicha*, the native beer, a large glass of which may be purchased for about two cents. When it is cleanly made, it is not disagreeable.

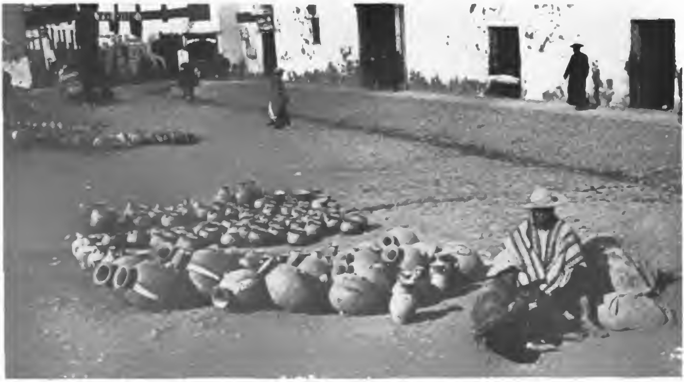


Photo by Hiram Bingham

A CORNER OF THE SAN FRANCISCO PLAZA: CUZCO

In the market-places of Cuzco and other Peruvian cities pottery made by the Indians in the vicinity is usually to be bought for prices ranging from five to fifty cents. It is hand made, baked in primitive ovens, and rudely decorated with variegated designs.

Photo by Hiram Bingham

A GRAVEL BANK CONTAINING BONES AND POTSHERDS: CUZCO (PAGES 500-501)

There are many places near Cuzco where in the stratified gravel banks bones and pieces of pottery may be found interstratified with the pebbles. Dr. Eaton and Lieutenant Sotomayor, on one of our first walks out of Cuzco, located a number of these.

this region.) Furthermore, the rock at Ñusta Espana bears in its carvings marks which indicate that at one time in the remote past it was unquestionably an object of veneration.

This evidence made me believe that at Ñusta Espana was the principal shrine of the ancient people in this entire region, and that the neighboring ruins of Rosaspata were in reality the ruins of Vitcos, the last Inca capital. An account of the discovery of these places and a statement of the proof on which we have based our conclusions may be found in *Harper's Magazine* for October, 1912, and in more extended form in the Proceedings of the American Antiquarian Society for April, 1912.

Returning to this location in August, 1912, I drained the marshes that partly surround the rock at Ñusta Espana and excavated as far as was practicable. To our surprise and mortification we were unable to find any artifacts whatever and only a handful of rough potsherds. We did uncover an interesting priestly throne containing nine seats. The work of excavating and the results may be seen on pages 553 and 554.

V

INCA PLACE NAMES IN THE VILCABAMBA REGION

A problem which particularly occupied my attention was the identification of ancient Inca place names referring to the Vilcabamba country and occurring in the Spanish chronicles, but not appearing on any known maps.

Before leaving New Haven I had an index prepared of all the places that are referred to in the available chronicles. A copy of this list was taken with me in the field wherever I went, and owing to the courtesy of the managers of various plantations and of local government officials, the most intelligent and reliable Indians were carefully questioned in regard to these places.

By this means it is believed that a considerable body of geographical nomenclature has been assembled, and it is hoped that in the future it may be possible to write a report that will elucidate and interpret some of the more difficult passages in the chronicles.

VI

EXPLORATION OF THE AOBAMBA VALLEY

As part of our plan to cover the area included between the Urubamba and Apurimac rivers, an archeological and topographical reconnaissance was made of the hitherto unexplored Aobamba Valley. Assistant Topographer Heald

Photo by Hiram Bingham

THE OSTEOLOGIST AT WORK: CUZCO VALLEY

In the north bank of the Huatanay River, a mile below Cuzco, Dr. Eaton found a human skeleton interstratified with clays and gravels 8 feet underground. Since the time when the bones were deposited there, the entire field of coarse gravels had been laid there above them, and in the succeding centuries the river had cut down the bank until it finally laid them bare (see pages 500 and 501).

undertook to approach this problem from the mouth of the valley at the junction of the Aobamba and Urubamba rivers. He met with almost insuperable difficulties.

Although the work looked easy as far as we could see from the mouth of the valley, he found that 4 miles from the mouth, up the winding stream, the jungle was so dense as to be almost impassable. There was no trail and the trees were so large and the foliage so dense that observations were impossible even after the trail had been cut. During a hard afternoon's work in jungle of this kind, with four or five men aiding in making the path, they succeeded in advancing only one mile.

Reconnaissance work in this type of jungle is extremely discouraging and unprofitable. Furthermore, there are occasionally some dangers—as, for instance, the following from Mr. Heald's account of his reconnaissance:

"On the way back to camp one of the men had a narrow escape from a snake, being grasped and held by another of the peons just in time to prevent his stepping on it. It was a small, dust-colored snake, about 10 inches long, and on being examined was found to possess two small poison fangs far back in the jaw. The fangs differed from those of most poisonous snakes in that they slanted back very little, coming almost straight down to the lower jaw."

THREE NEW GROUPS OF RUINS REPORTED.

There was little of archeological interest in the portion of the valley which Mr. Heald succeeded in reaching. Quite unexpectedly, however, I got into the upper reaches of the valley about ten days' later and found some interesting ruins and had an unexpected adventure. It happened on this wise:

The largest and richest estate in the Urubamba Valley, Huadquiña, is owned

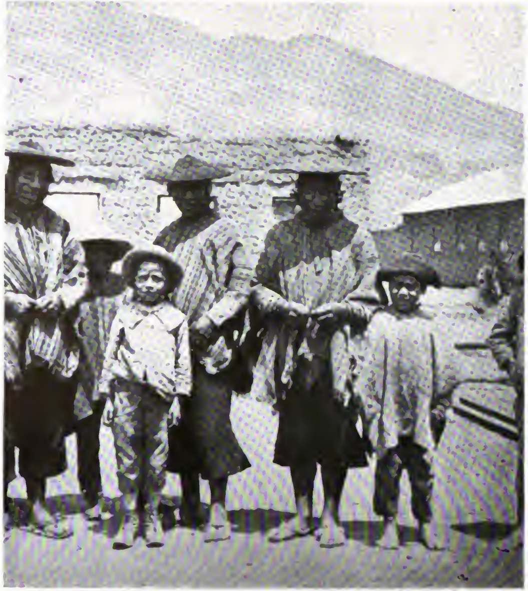


Photo by L. T. Nelson

TYPICAL PERUVIAN MOUNTAIN INDIANS

Indian men at a railroad station not far from Cuzco, smiling at the Doctor's efforts to get the picture. As it was a cloudy day with rain threatening, the hat was worn wrong side up.

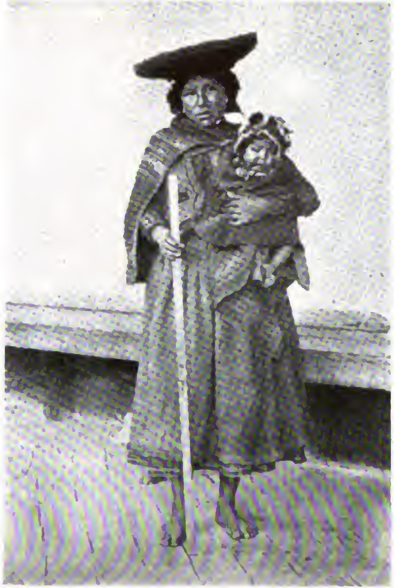


Photo by L. T. Nelson

A TYPICAL CUZCO INDIAN MOTHER AND BABY

She is patiently holding the surgeon's yardstick and wondering why she was having her picture taken

Photo by Hiram Bingham

GOATHERDS AND SHEPHERDS: CUZCO VALLEY

The shepherds of the Cuzco Valley are usually small boys who, like David of old, spend their early years with slings in their hands tending their flocks

Photo by Hiram Bingham

A ROMANTIC SHEEP PASTURE: TIPON, NEAR OROPESA

Frequently their sheep graze on ancient Inca terraces near carefully built retaining walls, or in the midst of interesting ruins about whose history we know practically nothing.

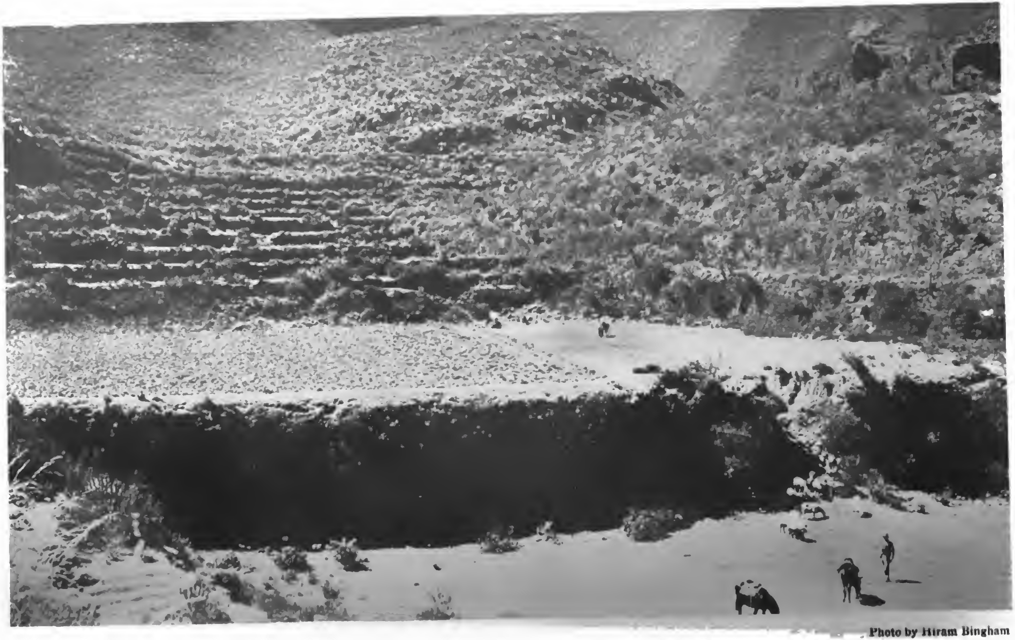


Photo by Hiram Bingham

A VALLEY THAT INVITES EXCAVATION: NEAR OROPESA

A general view of the ruins at Tipon, in the Cuzco Valley near Oropesa, where flocks are herded or crops raised on the ancient terraces

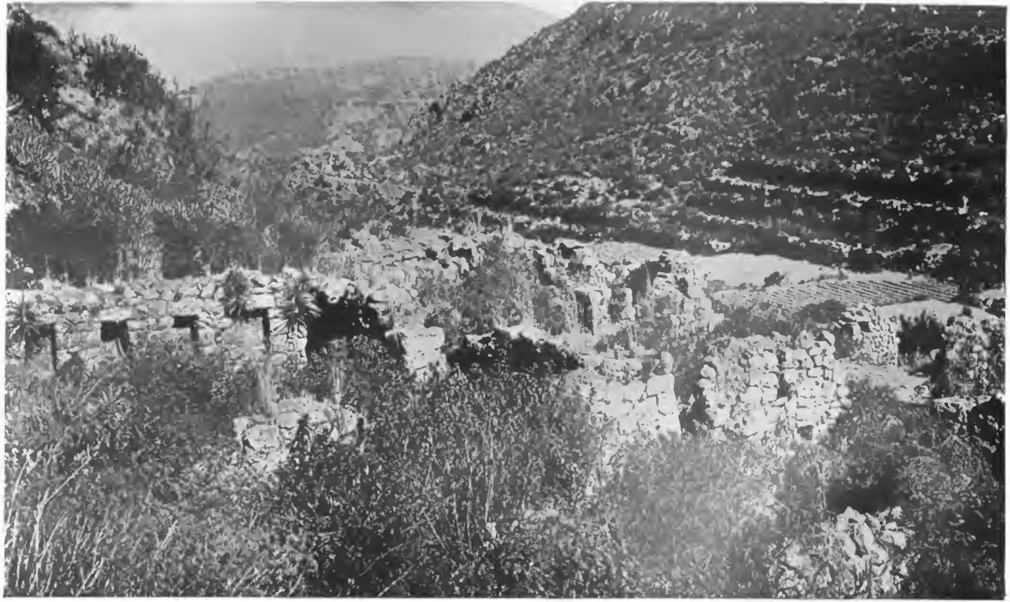


Photo by Hiram Bingham

A NEGLECTED SCIENTIFIC OPPORTUNITY: CUZCO VALLEY

Another view of the ruins at Tipon, near Oropesa. Recent unauthorized excavations by treasure hunters in this vicinity have brought to light important finds. This is one of the localities where careful systematic archeological excavation ought to be done in the near future. Although within a few miles of Cuzco, it has been visited by very few people.

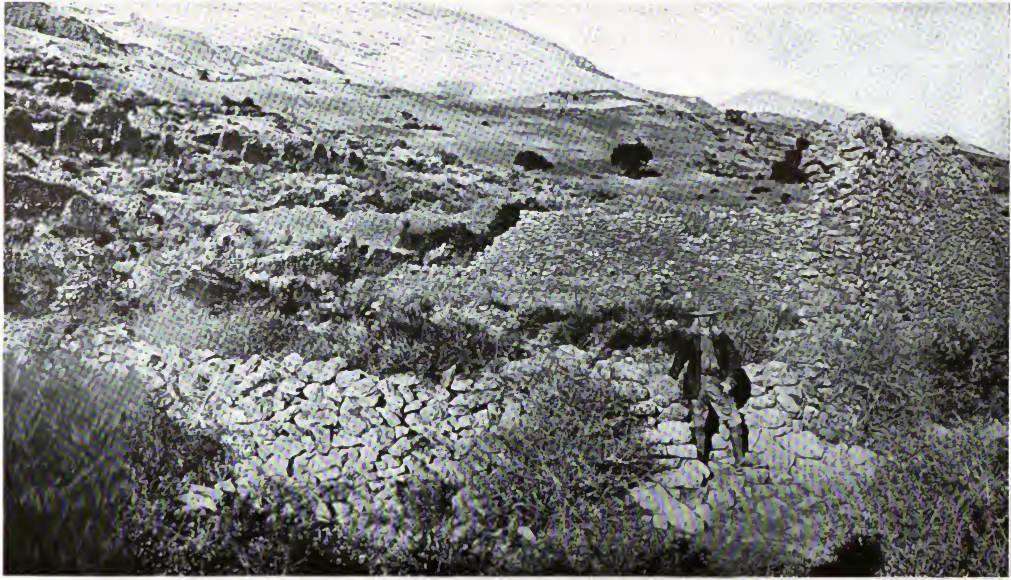


Photo by Hiram Bingham

THE RUINS OF PIQUILLACTA: CUZCO VALLEY

Not far from Tipon and below Oropesa are the ruins of a large city now known as Piquillacta. It is referred to in Squier's "Peru" on page 422, but he calls it Muyna. The walls of more than 100 houses are still standing, and yet practically nothing is known except through casual oral tradition regarding the builders of this ancient city. It is only an hour's walk from the railroad and deserves to be carefully studied by a well-equipped archeological expedition

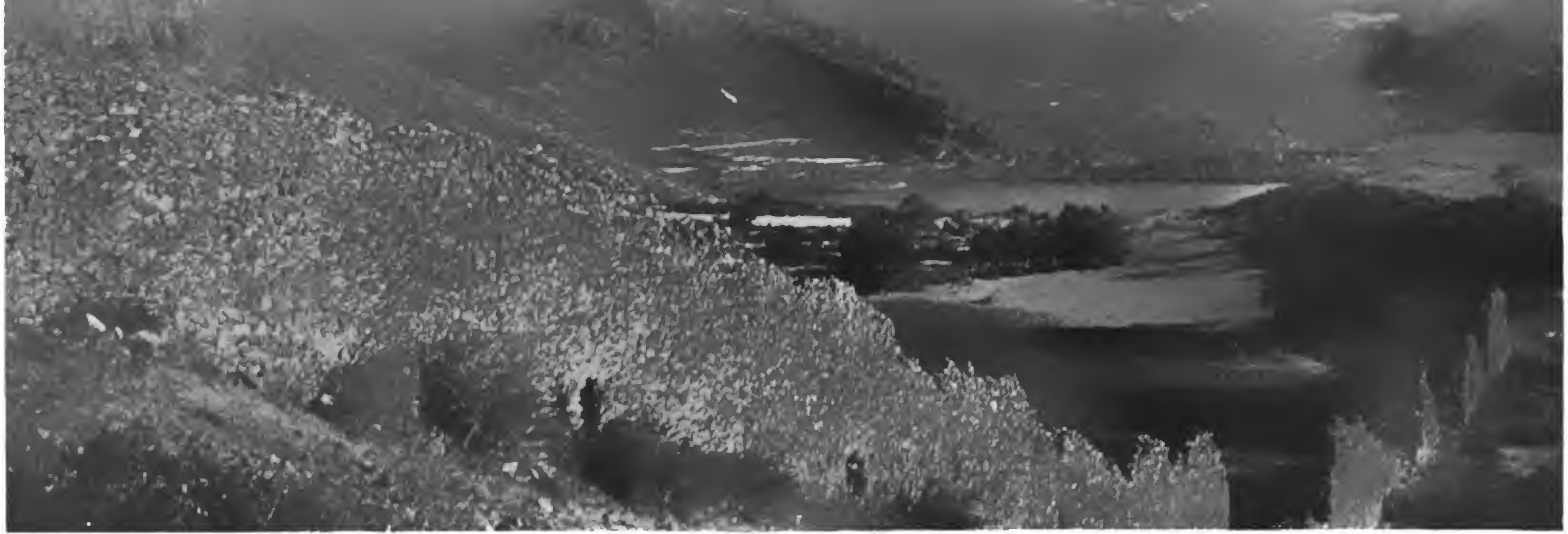


Photo by Hiram Bingham

THE CITY WALL OF PIQUILLACTA

The city of Piquillacta was protected by a long, high wall, which is here shown crossing the hill toward Lake Mohina. On the shores of Lake Mohina are other ruins which also need studying before treasure hunters have made it impossible to determine the age and relative historical position of the material.

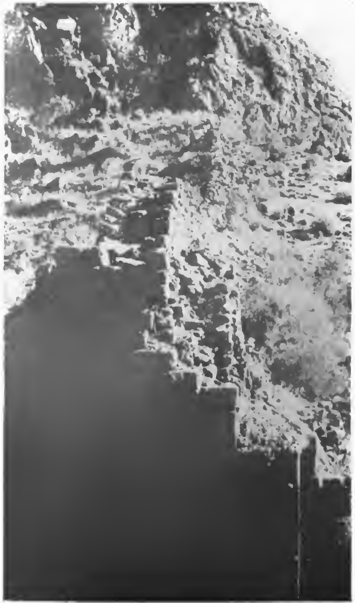


Photo by Hiram Bingham

THE SOUTH WALL OF RŪMI CCOLCA

Although the local tradition states that this wall was an aqueduct, the pitch at which it runs up the hill inclines one to believe that it was for defensive purposes, instead of being intended to convey water.

Photo by Hiram Bingham

A WALL IN PIQUILLACTA

The walls of a house in the ruined city of Piquillacta showing rough elementary niches and crude stonework. The walls, made of rough stones laid in clay and not fitted together, are sometimes over 20 feet in height

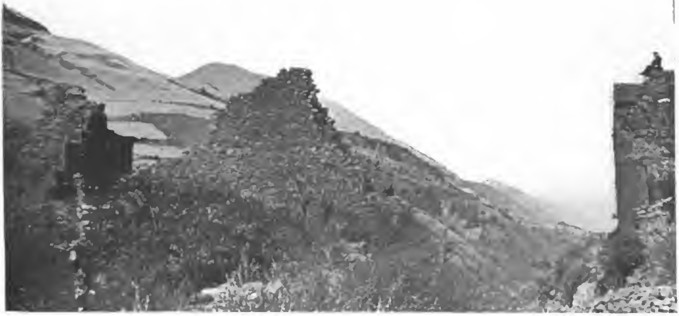


Photo by Hiram Bingham

THE RUINS OF RUMI CCOLCA

A short distance east of Piquillacta are the ruins called Rumi Ccolca. It is impossible to say positively whether this was merely a wall which guarded the entrance to the Cuzco Valley, or whether it was an aqueduct that once carried water to the city of Piquillacta.

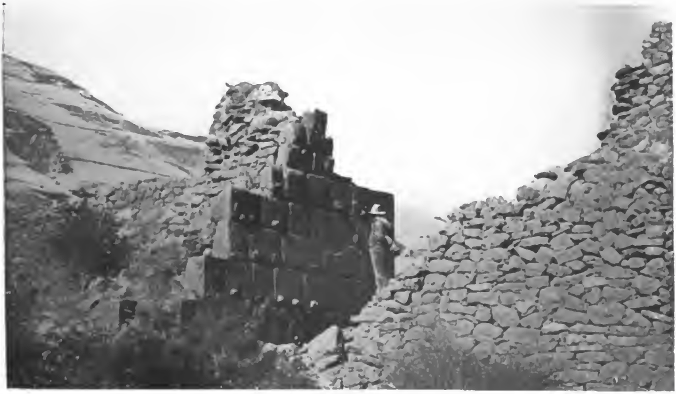


Photo by Hiram Bingham

AN ARCHITECTURAL PUZZLE: RUMI CCOLCA

A nearer view of Rumi Ccolca shows the junction of two entirely different kinds of stonework. The original wall is of rough stones laid in mud, but the gateway is lined with cut stones fitted together without mortar after the best Inca style. It may be possible that a later race cut a gate through the ancient aqueduct and lined it in their own fashion with their best stonework.

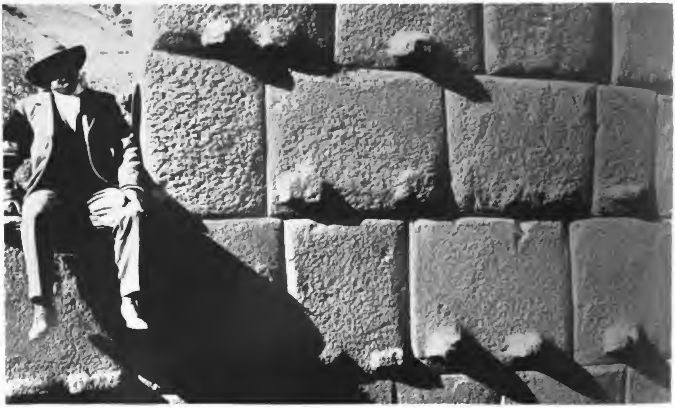


Photo by Hiram Bingham

THE FINEST STONEWORK AT RUMI CCOLCA: CUZCO VALLEY

A detail of one side of the gateway at Rumi Ccolca, which shows stone blocks cut with as much precision as the best work at Machu Picchu. The projecting nubbins left on these rocks are an echo of similar marks left on the stone inside the priest's house near the Sacred Plaza in Machu Picchu (see the picture on page 529).

by the Señora Carmen Vargas, who inherited from her father about 1,000 square miles of land lying between the Urubamba and Apurimac rivers. Some of the land is occupied by sugar plantations; other parts are given over to the raising of sheep and cattle, while a large portion is still tropical jungle. Señora Carmen has always received us most hospitably and done everything in her power to further our efforts.

Her son-in-law, Don Tomas Alvistur, an enthusiastic amateur archeologist, took a considerable amount of interest in our work and was quite delighted when he discovered that some of the Indians on the plantation knew of three localities where there were Inca ruins, so they said, that had not previously been visited by white men.

Don Tomas invited me to accompany him on a visit to these three groups of ruins, but when the time came to go he found that business engagements made it impossible for him to do more than accompany me part of the way to the first group. He went to the trouble, however, of securing three Indian guides and carriers and gave them orders to carry my small outfit whenever it was impossible for the pack-mule to be used, and to guide me safely to the three ruins and home again.

They did not greatly relish these orders, but as they were all feudal tenants, holding their land on condition of rendering a certain amount of personal service every year in lieu of rent, they were constrained to carry out the orders of their overlord.

After Don Tomas departed I was left to the tender mercies of the Indians and of my faithful muleteer, Luis. The Indians had told us that one could visit all three ruins and return the next day. This information, however, did not prevent me from putting in supplies for at least a five days' journey, although I little anticipated what was actually going to happen.

The end of the first day's journey found us on top of a ridge about 5,000 feet above the place where we had started, in the midst of a number of

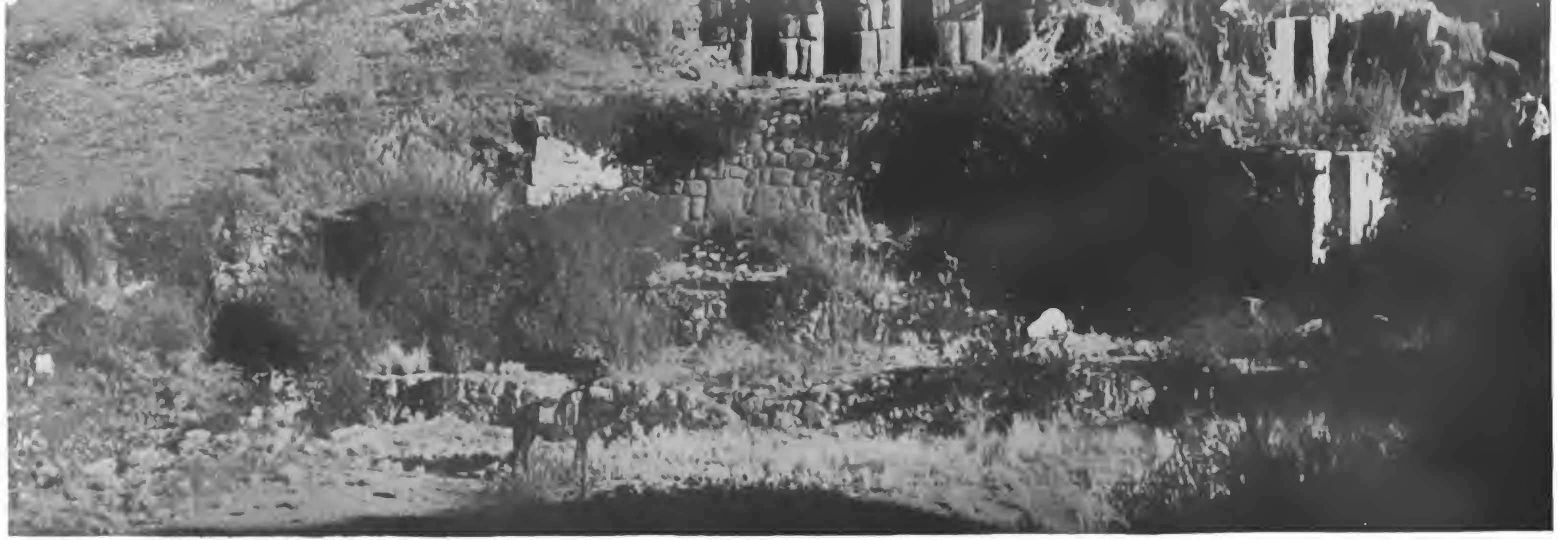


Photo by Hiram Bingham

TAMPU MACHAI: NEAR CUZCO

A two hours' ride from Cuzco are the ruins of Tampu Machai, near the ancient fortress of Pucara. There is a spring here whose waters contain remarkable mineral qualities. Around it the ancients built a fountain and the ruins seem to be those of a temple dedicated to the god of the spring. This is one of the places of the Cuzco Valley that most urgently demands scientific investigation and careful study.

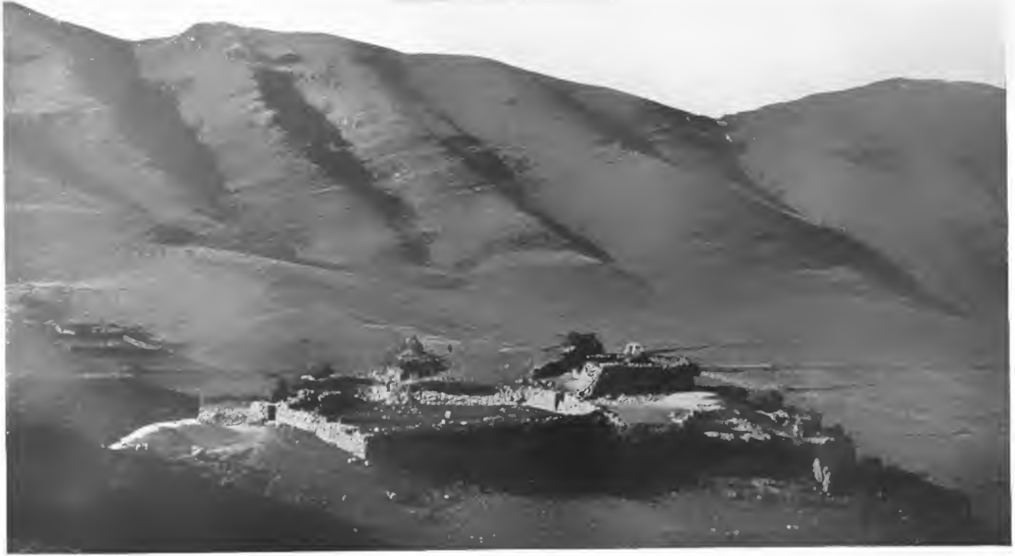


Photo by Hiram Bingham

PUCARA: AN ANCIENT FORTRESS NEAR CUZCO

The fortress of Pucara on the ancient trail between Cuzco and Calca, which passes over the gap shown in the picture. Some of the structures in this little fortress are of exquisite stonework, and the presence of symmetrical niches and carefully cut drains connects it, however slightly, with the people who built Machu Picchu.

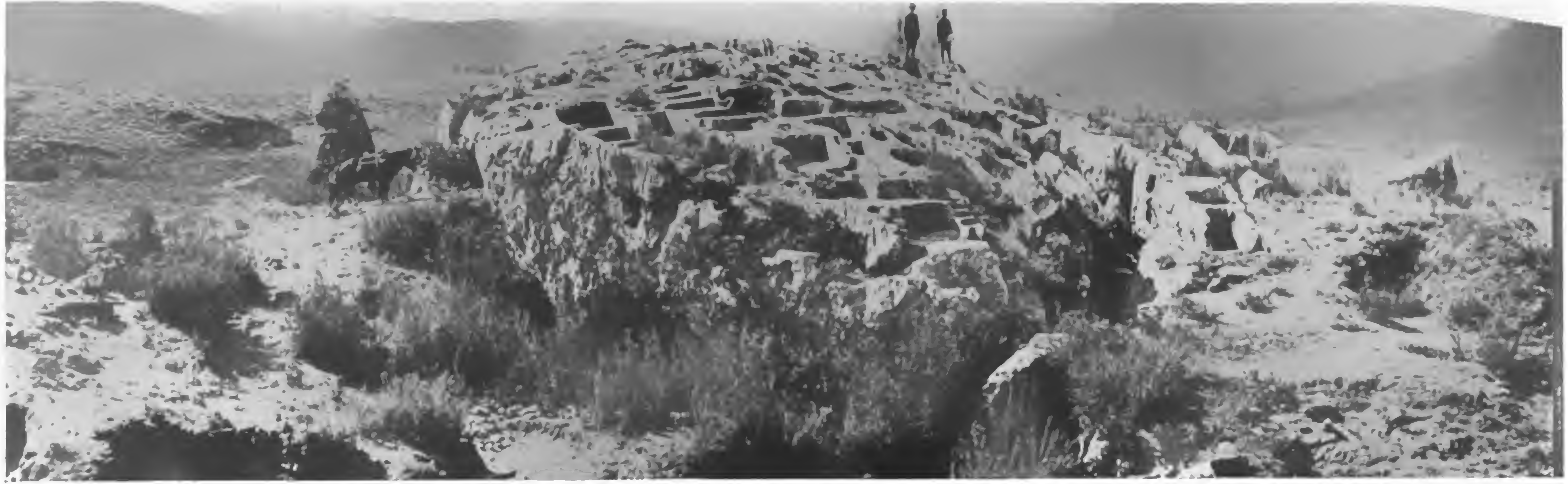


Photo by Hiram Bingham

THE ROCK OF KKENKO, NEAR CUZCO

Nearer Cuzco and more celebrated than any other of the ruins just referred to is the carved rock called Kkenko, an ancient shrine that has been frequently visited by archeologists

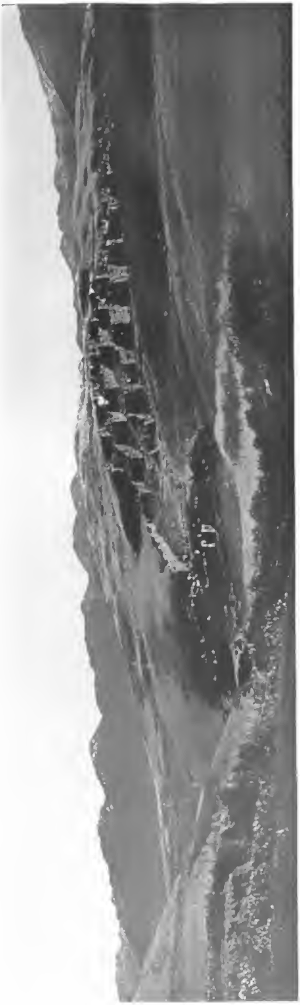


Photo by Hiram Bingham

THE WONDERFUL FORTRESS OF SACSAHUAMAN: CUZCO VALLEY

Near Kkenko and still nearer to Cuzco are the remarkable walls of the cyclopean fortress called Sacsahuaman. Many of the stones in its construction are over ten feet in height. The most complete recent description of it may be found in Chapter III of Ambassador Bryce's book on South America. Mr. Bryce says that this fortress is "one of the most impressive monuments of prehistoric times that the world contains." He believes that it belongs to a very early time, and is the work of a primitive people long anterior to those historical Incas whom the Spaniards overthrew.

primitive ruins and two or three modern huts.

LLACTA PATA, THE RUINS OF AN INCA CASTLE

This place was called Llacta Pata. We found evidence that some Inca chieftain had built his castle here and had included in the plan ten or a dozen buildings. They are made of rough stones laid in mud, with the usual symmetrical arrangement of doors and niches. It would be interesting to excavate here for three or four weeks and get sufficient evidence in the way of sherds and artifacts to show just what connection the people who built and occupied this mountain stronghold had to the other occupants of the valley.

After measuring the ruins (see plan, page 556) and taking a few photographs (see page 555), I asked the Indians how far it was to the next group of ruins, and was told it was "two or three hours' journey."

Possibly it *could* be done by an Indian runner, with nothing to carry, in four or five hours, but we had three mules, that is, our two saddle-mules and the one pack-mule, whose load, weighing about 100 pounds, included a small tent, cooking outfit, blankets, and enough provisions for five days.

Although I had selected for this journey one of the best and strongest pack-mules which we possessed, and although his load was not much more than a third of what he could comfortably carry on a good road, he found it impossible to carry this load over the trail that we found before us.

During the first two or three hours the trail passed through a dense tropical jungle. We

Photo by Hiram Bingham

A SMALL CHAPEL ON THE OUTSKIRTS OF ABANCAY

With characteristic hospitality when I left Abancay on my way to Cuzco, I was accompanied this far by the prefect and his aide, and was sent on my way rejoicing and riding one of the prefect's best horses, while my own mule had a day off. It is this generous spirit of friendly courtesy that makes the work of exploration pleasant in a region where nature has done all she could to make it difficult.

repeatedly had to make detours to avoid deep sloughs, and occasionally had to stop in order to have branches cut away so that the mules might get through.

DIFFICULT GOING.

The trail grew rapidly worse, the pack-mule fell down four or five times, and finally became so frightened that he refused to attempt a place in the trail where it was necessary for him to jump up about four feet on a slippery rock. It was consequently necessary to unload him and distribute the cargo among the Indian carriers, and get all hands to help pull and push the mules over the bad spots in the mountain foot trail. This went on at intervals during the remainder of the day.

As a result we found ourselves at nightfall on a grassy slope on the side of the mountain about 15,000 feet above sea-level. A little shelter here and the presence of a small spring made the Indians prefer to pass the night at this point.

The next morning we crossed a high pass and descended rapidly into a steep-walled valley, containing one of the upper tributaries of the Aobamba. The lower slopes were covered with a dense forest, which gradually gave way to scrub and grass up to the snow-line. About 2 o'clock in the afternoon we reached the valley bottom at a point where several smaller tributaries unite to form the principal west branch of the Aobamba. The place was called Palcay.

Here we found two or three modern Indian huts, one of them located in a very interesting ruined stronghold called Llacta. As the location of the stronghold in the bottom of a valley was not easily defensible, a wall about 12 feet in height surrounded the quadrangular ruin.

The stronghold was about 145 feet square and divided by two narrow cross-streets into four equal quarters. Two of these quarters had been completed, and consisted of five houses arranged around a courtyard in a symmetrical fashion. The third quarter was almost complete, while the fourth quarter had only the beginnings of two or three houses. Each one of the four quarters had a single en-

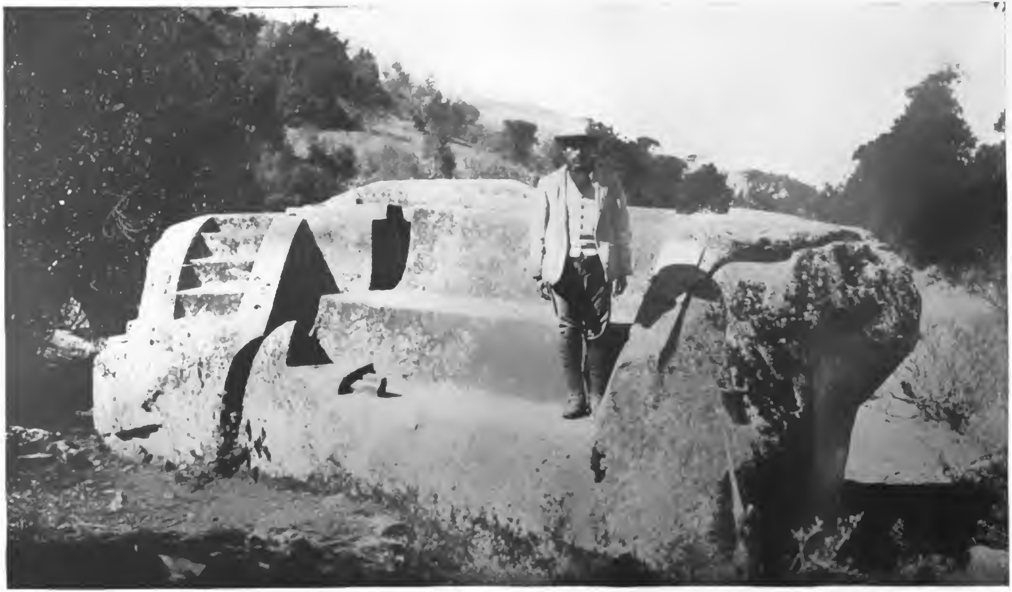


Photo by Hiram Bingham

THE CURIOUS ROCKS OF CONCACHA

Near Abancay, where the topographical cross-section of the Andes was begun in 1912, are some extraordinary carved rocks at a place called Concacha. This one is called by the Indians Rumihuasi, or stone house. It has been inadequately described by several travelers and the vicinity is one that demands early systematic investigation.

Photo by Hiram Bingham

ANOTHER VIEW OF THE STONE HOUSE: RUMIHUASI

Showing the cell where some people suppose a hermit passed his time, while his life was devoted to painfully decorating this boulder by the means of such rude stone implements as he had at hand.

trance gate on its north side. This will be more readily understood by consulting the plan on page 559.

The characteristics of the buildings are distinctly Inca and resemble in many ways those found at Choqquequirau in 1909. The stronghold was made of blocks of stone laid in mud, the buildings of symmetrical pattern, with doors narrower at the top than at the bottom; no windows, but interior ornaments of niches and projecting cylinders alternating between the niches. Whenever the wind did not blow, the gnats were very bad, which made the work of measuring and mapping the ruins extremely annoying.

DESERTED BY THE INDIAN GUIDES

I should like to have continued the journey the next day, but the Indians objected, saying that it was Sunday and that they needed the rest. This "rest" gave them an opportunity for concocting a plan of escape, and on Monday morning, when I was ready to start for the third group of ruins, there were no guides or carriers in sight.

Neither Luis nor I had ever been in the region before. We could of course have gone back on foot over the trail on which we had come, but it was very doubtful whether we could have succeeded in getting our mules over that trail, even though we had abandoned our outfit, and we knew that a loaded mule could not possibly go over the trail without constant assistance and a number of helping hands.

To aid us in our dilemma there came a little Indian who inhabited one of the huts near the ruins. He offered for a consideration to guide us out of the valley by another road, and said that it went near the other ruins. He also said that it might not be possible to use this road "if the pass had much snow in it."

We talked to him with difficulty, for, like most mountain Indians, he had no knowledge of Spanish, and our own knowledge of Quichua was somewhat limited. However, there was nothing for it but to follow our new guide, and by distributing the cargo on the three mules make it as easy as possible for the poor beasts to use the foot-path, or goat trail, which was indicated as our "road."

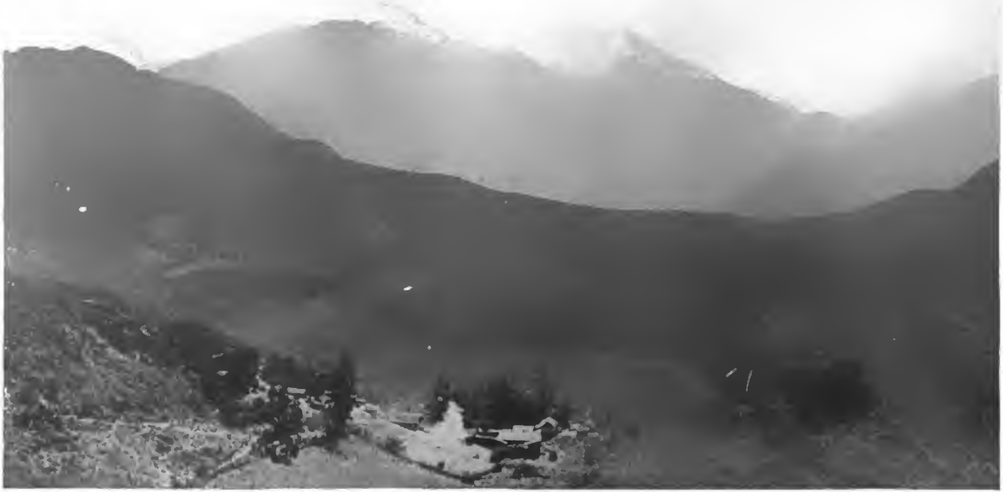


Photo by Hiram Bingham

A SUGAR PLANTATION IN THE APURIMAC VALLEY

Near Abancay are many charming sugar plantations which are noted for their hospitality. He is indeed a favored traveler whose journey lies through this hospitable region, where he is sure of a warm welcome at the end of his day's journey and the best that the house affords. Many of the sugar planters have traveled abroad and their houses are supplied with comfortable furniture, books, pianos, and even phonographs and pianolas that have been brought over the mountains either on the backs of men or mules.

Photo by Hiram Bingham

THE OTHER IMPORTANT CARVED ROCK AT CONCACHA (SEE PAGE 536)

Called Piedra Labrada, which is simply the Spanish for "carved rock." It was once one of the most extraordinary monoliths in South America. But within the past forty years it has been terribly mutilated. Remains of the animals and strange figures are still to be seen, but most of the heads have been destroyed either through superstition or caprice. Its present state is a glaring example of the necessity for preserving the ancient ruins of Peru, and for sending properly equipped expeditions to study these ancient sites before the historical evidence they contain is lost owing to ignorance or greed.

We had not gone more than half a mile before an abrupt ascent in the trail and a huge sloping rock barred the way for the mules for over half an hour. This difficulty being surmounted, we went on for another mile, only to find our way crossed by a huge avalanche of gigantic granite boulders and glacial drift, which had come down from the slopes of Mount Salcantay during the past year. A couple of hours were spent in negotiating the trail across this landslide.

We then found ourselves near the ruins of a village. Judging by the primitive appearance of the ruins, it could not have been a place of much importance and it is impossible to say whether it had been occupied since the Spanish conquest or not.

THE DISCOVERY OF TEN MAGNIFICENT GLACIERS

Climbing up the valley beyond this ruined village and turning a corner, we came into full view of 10 magnificent glaciers—eight of them in a cirque in front of us and two on the slopes of Salcantay behind us. As the guide was very well informed as to the names of different parts of the valley and could give names for most of the peaks but none for any for the glaciers, I have named these as follows (pp. 560, 563-5):

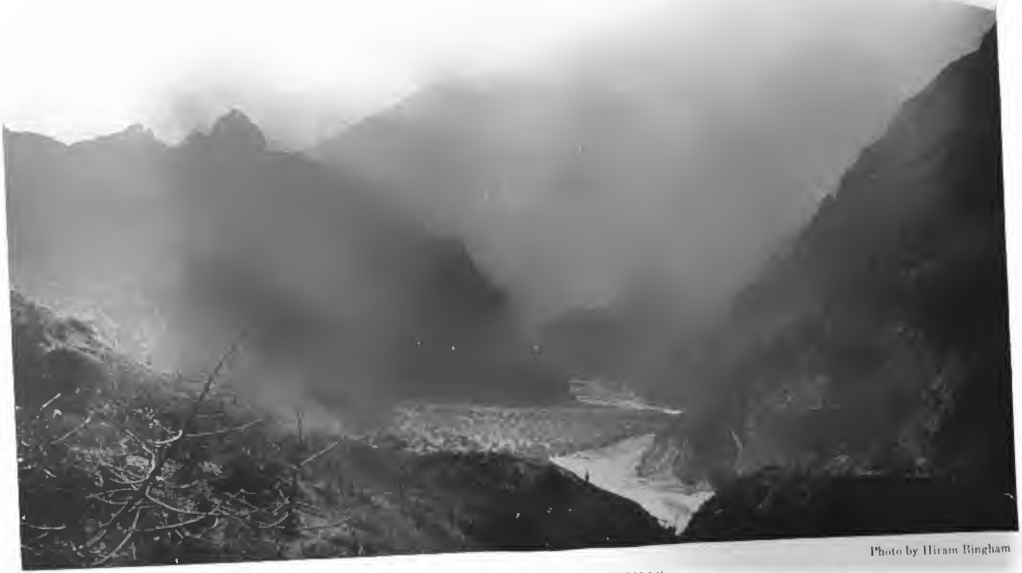


Photo by Hiram Bingham

THE GRAND CAÑON OF THE APURIMAC

A bit of the Apurimac Valley between La Estrella and Abancay. If the Pan-American Railway is ever completed, one of its most interesting sections and one involving tremendous engineering difficulties will be in this immediate vicinity, where the road from Cuzco to Lima crosses this magnificent tributary of the Amazon

Photo by Hiram Bingham

MAP MAKING IN THE APURIMAC VALLEY

Chief Topographer Bumstead working at his plane table making the map between Abancay and Pasaje. The difficulties of map making in cañons, varying from 4,000 to 10,000 feet in depth, can scarcely be appreciated except by practical engineers (see pages 506, 507).

(1) *Hadley Glacier,* in honor of the President of Yale University.

(2) *Gannett Glacier,* in honor of the President of the National Geographic Society.

(3) *Grosvenor Glacier,* in honor of the Editor and Director of the National Geographic Society.

(4) *Bryce Glacier,* in honor of His Excellency James Bryce, the British Ambassador, whose interest and enthusiastic support has greatly stimulated our work.

(5) *Harkness Glacier,* in honor of Edward S. Harkness, Esq., of New York, whose generous assistance was largely responsible for making possible the expeditions of 1911 and 1912.

(6) *Alfreda Mitchell Glacier,* in honor of my wife, without whose coöperation none of this work could have been done.

(7) *Taft Glacier,* in recognition of the courteous assistance we received from the United States government.

(8) *Leguia Glacier,* in recognition of the courteous assistance we received from the Peruvian government.

(9) *Morkill Glacier,* in recognition of the courteous assistance we received from the Peruvian corporation.

(10) *Yale Glacier*—for obvious reasons (see pages 560, 563-565).

While we were enjoying the wonderful spectacle and wondering whether any civilized being had ever seen the glaciers before, a magnificent gray deer with eight prongs to his horns sprang out of the grass near us, gave us a long look of interested interrogation, and then dashed off to find his friends.

Our little guide was more interested in the looks of the pass than in the deer, and although he shook his head as it came into view, it seemed to us that we were most fortunate, for there appeared to be no snow whatever on the trail all the way to the top of the pass. But we neglected to take into account the fact that we were approaching the pass from the north or sunny side, and that there might be snow on the trail on the other side of the pass, on the south or shady slope.

THE GRANDEUR OF THE SCENERY

All thoughts of this, however, were temporarily swept aside by the magnificent view of Salcantay, which we now had on our right hand. The picture on p. 563 gives but a faint idea of the grandeur of this mountain. In many ways it is an ideally beautiful peak, rising as it does to a sharp point, with its sides cov-

Photo by Paul Bestor

THE FERRY AT PASAJE: APURIMAC VALLEY

The Director crossing the Apurimac River on a raft at Pasaje. The Indian ferryman is looking back in astonishment that a "gringo" should know how to use a paddle

ered with snow and ice, and lifting its head so magnificently thousands of feet higher than anything else in the vicinity.

Our own elevation at the time was a little over 16,000 feet, and a conservative estimate would place the top of the mountain at least 5,000 feet above us. It was a very great disappointment that we were unable, owing to the bad weather, to get the mountain triangulated, so that its height still remains an unknown quantity.

The American mining engineers at Ferrobamba believe it to be the highest peak in the Andes, and Mr. Stevens, the superintendent of the mine, which is nearly 100 miles away from the mountain, told me that he had seen it from so many distant points of the Andes that he felt confident it must be the highest mountain in South America.

Just before getting to the top of the pass we turned aside for a few moments to see the remains of a hole in the ground where it is said that there was once an ancient gold mine.

A few specimens of rock brought from the talings appear to contain small quantities of silver and copper, but the altitude is so great and the surroundings so difficult that it is not likely that this mine will ever be a profitable working proposition.

THE MULES STAMPEDE ON A SNOW SLOPE

Our joy in the scarcity of snow on the north side of the pass was instantly reduced to despair when we reached the summit and looked down a precipitous slope covered with snow for a distance of at least 1,000 feet below us.

The sandal-shod mountain Indians, whose occasional huts are the only signs of human habitation hereabouts, had made a zig-zag path in the snow by means of tramping down the upper crust with roughly cut stumps of stunted mountain trees. The path was about eight inches wide.

Our mules had never been in the snow before. At first our Indian guide declared he would not go down with us, as he was afraid of snow blindness, but he was persuaded to accompany us.

Our mules took a few steps on the little path, then decided that the white snow field looked more inviting and left the

Photo by Hiram Bingham

A VIEW OF PANTA MOUNTAIN

Between Pasaje on the Apurimac and Lucma lies a remarkable mountain region of glaciers and snowy peaks, of which the finest is Panta Mountain. The making of the map in this vicinity was accompanied by great hardships and innumerable difficulties.

path, fell into the soft snow up to their ears, floundered around and attempted to stampede, and rolled down the side of the mountain. It was nearly half an hour before we got them safely back on the trail again, where they stood trembling and unwilling to attempt the descent. Coaxing and curses were equally of no avail. Pulling, hauling, and beating were alternately resorted to.

Somehow or other, chiefly because our trail lay down hill, so that when they fell and floundered off the path they always landed a little nearer to their goal than when they had started, we eventually got the mules to the foot of the declivity, but only after several narrow escapes and three hours of hard work. As we looked back up the trail it seemed that perhaps 1,500 feet would be a more exact estimate of the height of the snow-covered slope.

Just at dusk we reached the first hut in the valley, and found that we were in one of the upper branches of the Chamaná River, a tributary of the Urubamba, which Mr. Tucker, of the 1911 expedition, had reconnoitered the preceding year.

DISCOVERY OF THE PICTOGRAPHIC ROCK.

In this valley was the third group of ruins which we had been told about. Their most unusual feature lay in the fact that the Incas, desiring to save as much of the upland valley floor as possible for agricultural purposes, had straightened the bed of the meandering stream and inclosed it in a stone-lined channel, making it practically perfectly straight for nearly three-quarters of a mile.

The valley is still used to a certain extent for raising and freezing potatoes. The owner of the hut near which we camped entertained our Indian guide in compensation for his assistance in spreading potatoes to be frozen that night some distance below us in the valley bottom. The next day our guide took us back up the valley and out through a smaller tributary, where we crossed the divide between the Urubamba and Apurimac valleys and descended toward the town of Limatambo.

This was one of the most fortunate accidents of the trip, for had we decided to go down the Chamaná over Mr. Tuck-

Photo by Hiram Bingham

ANOTHER VIEW OF PANTA MOUNTAIN FROM NEAR CHOQUETIRA

Photo by Hiram Bingham

THE TRAIL FROM ARMA TO CHOQUETIRA

Panta Mountain from the pass near Arma, showing the trail along the mountain-side. One of the stations in this vicinity occupied b Chief Topographer Bumstead in his survey was at an elevation over 18,000 feet above the sea.

Photo by Hiram Bingham

MOUNT SOIROCCOCHA NEAR PANTA MOUNTAIN

From the pass between Arma and Puquiura. These peaks are all in the neighborhood of 20,000 feet above the sea, have never been climbed, and offer an attractive field for hardy mountaineers.

Photo by Hiram Bingham

THE ARMA VALLEY

Another view of Mount Soiroccocha and the Arma Valley from our camp near an abandoned house

Photo by Hiram Bingham

EXPLORING ONLY 13 DEGREES FROM THE EQUATOR

The caravan crossing a pass near Panta Mountain. The elevation here is about 15,000 feet; the latitude is 13 degrees S.

er's route and return quickly down the Urubamba to our starting point, we should have missed seeing a most interesting rock which lay alongside of the little path we followed on this day's journey.

Neither the guide nor the muleteer had their eyes open for petroglyphic or pictographic markings, and so did not notice that they had passed close to the only rock so far discovered in the department of Cuzco that contains petroglyphs. Others have been reported by vague rumor, but none so far have been located except this one, whose existence was known to one or two cowboys on a neighboring ranch. The photograph gives a better idea of the markings than can be expressed in words (see page 566).

The character of the petroglyphs is essentially savage. They remind one of some of the glyphs used by our own western Indians. It seems to me possible that these marks were left on this rock by an Amazon Indian tribe who came thus far on the road to Cuzco. In the vicinity there were a few groups of stones which might indicate the former presence of rude huts, but until a comparative study can be made of all the pictographs and petroglyphs in Peru and in the Amazon basin it will be difficult to speak very definitely about this new discovery.

That night I was most hospitably entertained at a small ranch house and the next day made a forced march to Cuzco, reaching there shortly before midnight. This journey, which began so inauspiciously and might have ended in disastrous failure, actually produced more results in the discovery of hitherto undescribed ruins than any other part of the work.

VII

CHOQQUEQUIRAU.

In 1909, owing to the courtesy of the Peruvian government and at their urgent invitation, I had visited the ruins of Choqquequirau. An account of this visit was published in the *American Anthropologist* for October-December, 1910 (pages 505-525), and also in my *Across South America,* pages 291-323.

A French expedition had visited the ruins about 60 years before and had reached them from the north, over a path that has turned back several expedi-

Photo by Hiram Bingham

EXPLORING FIVE HOURS LATER

Five hours after crossing the snow pass shown in the last picture we were going through a dense tropical jungle at an elevation of 10,000 feet above the sea. This proximity of the Arctic regions to the tropical is one of the most striking and at the same time one of the most trying features of the work of Peruvian exploration.

Photo by Hiram Bingham

THE VILCABAMBA VALLEY

A view of the Vilcabamba Valley from an elevation of 14,600 feet above the sea, near the pass between Puquiura and Arma

tions since then. In 1909, owing to the existence of a small temporary bridge, I was able to reach them from the south, but had not found it possible to spend more than four days there.

That bridge disappeared some time ago, and as it was now deemed advisable to attempt a further reconnaissance of those celebrated ruins, I asked Mr. Heald to see whether he could not reach them from the north, across the cordillera of Vilcabamba. An enthusiastic young German merchant in Cuzco had attempted this feat two years before, but failed to get more than half way from Yanama, the nearest settlement.

Knowing Mr. Heald's pluck, I felt sure that he could get there if anybody could, but that if he failed the only alternative must be to reconstruct the bridge over the Apurimac. The latter would have been a serious undertaking, as the river is over 200 feet wide and the rapids are strong and very dangerous.

Mr. Heald not only succeeded in reaching Choqquequirau, but visited the place three times, made a passable trail, and was able to conduct thither Dr. Eaton and Dr. Nelson. Their stay was limited by the very great difficulties which they encountered in securing laborers to accompany them, and in carrying sufficient food for themselves and the laborers over the extremely rough country.

A HARD DAY'S WORK

As a sample of the difficulties encountered, let me quote the following from Mr. Heald's account of his first day out from Yanama:

". . . After a three hours' climb we reached a spot well above 14,000 feet and had a splendid view of the country. From here I could get an idea of the kind of traveling I would encounter, and it did not look very inviting. Where the jungle was not thick the mountain-sides were steep and rocky. I could see the course of the Apurimac, somewhere near which was Choqque-

Photo by Hiram Bingham

OUR CARAVAN CROSSING THE PASS BETWEEN ARMA AND PUQUIURA: THE PASS OF CHUCUITO

Photo by Hiram Bingham

THE HOUSE OF ANDREAS QUINTANILLA: PUQUIURA

A typical hut at Puquiura, in the Vilcabamba Valley, where we were hospitably entertained for several days during the preliminary work of excavating the monolith and shrine at Ñusta Espana, near Vitcos.

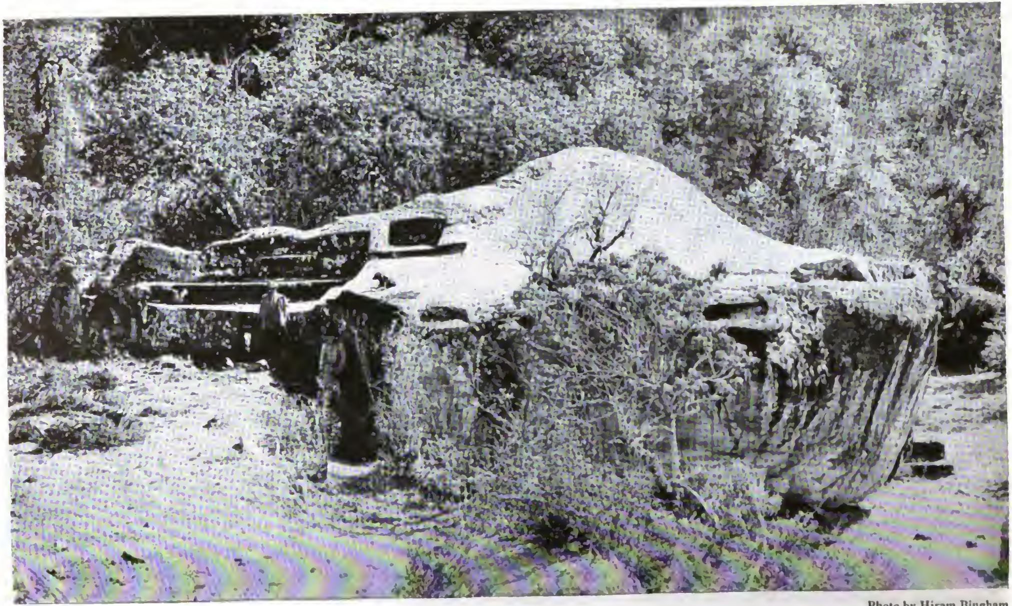


Photo by Hiram Bingham

THE SACRED WHITE ROCK NEAR VITCOS

A general view of the great monolith at Ñusta Espana, near Puquiura. Part of the rock overhangs a spring of water. This shrine is described in the early chronicles of Augustinian missionaries. Near here was Vitcos, the last Inca capital (see text, pages 511-513)

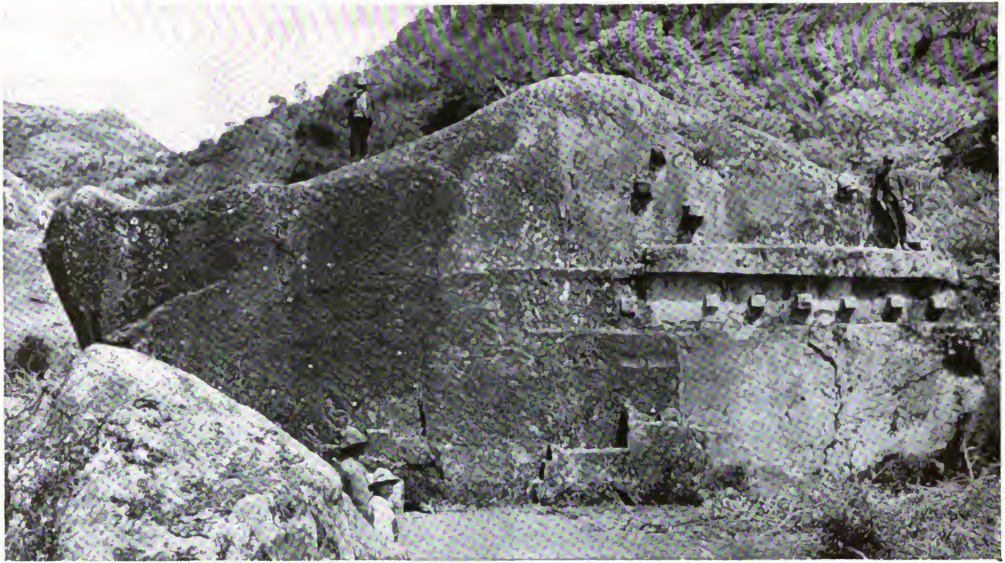


Photo by Hiram Bingham

ANOTHER VIEW OF THE SACRED WHITE ROCK, ÑUSTA ESPANA, NEAR VITCOS

The rock has evidently been flattened artificially and carved in rough relief. There are ten projecting square stones, seven of them in a line; and three above are carved out of the face of the stone. If these stones were intended to cast a shadow, it is significant that they were carved on the north side of the rock, where they would always be exposed to the sun.

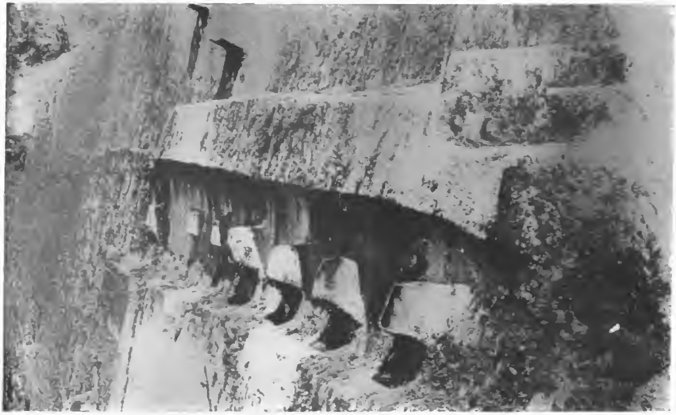


Photo by Hiram Bingham

ROCK CARVING AT ÑUSTA ESPANA

A detail of some of the carving on the great monolith at Ñusta Espana. These projecting stones remind one of Machu Picchu, where they are frequently in evidence, and seem to have been used for practical as well as ornamental and religious purposes.

quirau, and the green cane fields in the province of Abancay, on the other side.

"From a purely artistic point of view the country was wonderful, with its splendid ranges of gleaming white peaks all covered by glaciers, and the dark green of the jungle below leading down into straight-sided valleys with streams white with foam running down them. From the point of view of one who had to travel through it for the purpose of getting to a place, location unknown, and making a trail to that place, it was anything but lovely. . . .

"After looking my fill and taking compass readings on Yanama and various prominent points, we started down. There had been condors swinging above us ever since we had reached the high point, and now one flew quite close. I fired at him with the 22 Winchester automatic, and for a moment thought he was going to fall. He recovered his balance, however, and went sailing off; but after traveling about half a mile he suddenly collapsed and fell, turning over and over and over into the brush, where, after quite a hunt, we found him, dead.

"He was a splendid bird, spreading a little over 9 feet 6 inches and measuring 4 feet from bill to tail tip. This shot showed both the hitting power of the little 22 and the wonderful vitality of the condor. The mushroom bullet had gone through breast and breast-bone, lungs, liver, and intestines, lodging against a thigh-bone. Tomás carried the bird back to the hacienda, where the prowess of the little rifle caused much admiration. We took off the skin and spread it to dry on one of the frames built to jerk meat, of which there were several in the yard. Next morning it was nowhere to be seen, and, as the mayor-domo said that it was no use looking for it, I surmised that he knew where it was and agreed with him. . . ."

TROUBLE WITH BEARS AND JUNGLE FLIES

Dr. Eaton's party had some trouble with hungry bears, which broke open a food box and devoured a quantity of precious provisions. These bears belong to the *spectacled-bear* genus, and, although plentiful in this region, are extremely shy and hard to get a shot at.

The perils of the trail were many, but the most serious handicap, as every explorer has found in this region before, and the most annoying thing they had to endure, was the ever-present swarms of green jungle-flies. Mr. Heald says in his report:

"They are little fellows, but the way they bite is not the least in proportion to their size. Every place they bite they leave a blood-spot the size of a pin-head, and this burns and itches for two or three days. There were swarms of them, and soon we were all swelling. The only thing we could do was to grin and bear it. When we stopped to rest we made a smudge, but while traveling the best we could do was to slaughter as many as we could.

". . . With the coming of dark the flies had left us, but they left us in very bad shape. Not a man of us could bend his wrists, they were so swollen; the knuckles on the hands were invisible, and our eyes were mere slits that it cost an effort to open enough to look out of. Still, there was a lot to be thankful for. There was lots of dry wood where we stopped, and we soon had a fire going, which warmed and dried us. The night was clear, so there was no danger of being gotten out of bed by rain. I had shot a jungle duck, and the inner man was perfectly satisfied. What bothered me most was that I was afraid the peons would try to run away, and I very much doubted my ability to carry enough food to enable us to find Choqquequirau without their help. . . ."

Photo by Hiram Bingham

ANOTHER VIEW OF THE MONOLITH NEAR VITCOS

The east end of the monolith at Ñusta Espana overhangs a spring. Near this was what appeared at first to be a stone platform. The pictures on page 554 show what our excavations revealed at this point.

THE SCARCITY OF WATER AND SUFFERING FROM THIRST.

Their most serious difficulty, however, was the lack of water and the height and steepness of the mountains, which cut them off from any possible water supply. Here is a sample of what they suffered:

"The next morning, when I went to fill my canteen with water, I found that there was none. The men said that they had drunk it, but I felt pretty sure that they had poured it out, believing that then we would have to turn back. I would have done so (though no farther than the spring we had uncovered the day before), but the Director had told me there was a spring easily found at Choqquequirau, and I was confident that we must be near the place.

"In front of us rose a sharp ridge. I was sure that if we gained its top we would see the city on the other side. The fire had cleared the ground, so going was not hard; it had also cleared out the flies. After about two hours of climbing we stood on top of the lowest saddle of the ridge. This had been reached after some rather ticklish cliff-climbing. On looking over the other side we were tremendously disappointed, for instead of a city there was an impassable ravine. All the morning we worked along

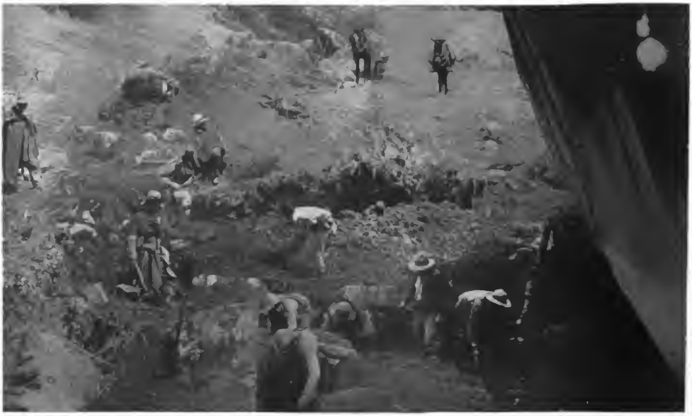


Photo by Hiram Bingham

COMMENCING EXCAVATIONS AT ÑUSTA ESPANA NEAR PUQUIURA, NEAR THE STONE PLATFORM SHOWN IN THE LAST PICTURE

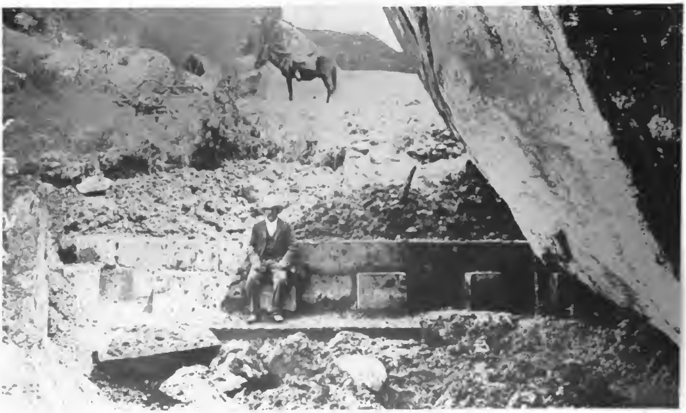


Photo by Hiram Bingham

THE RESULTS OF EXCAVATION AT ÑUSTA ESPANA

The seats near the spring at Ñusta Espana after excavation. They are cut out of large rocks, so that the platform on which they rest, the seats themselves, and the lower portion of the back are all part of the same rock. Thus only three or four large rocks were used for the entire row of seats. The excavations here yielded no results in the way of potsherds or artifacts (see page 520).

Photo by Hiram Bingham

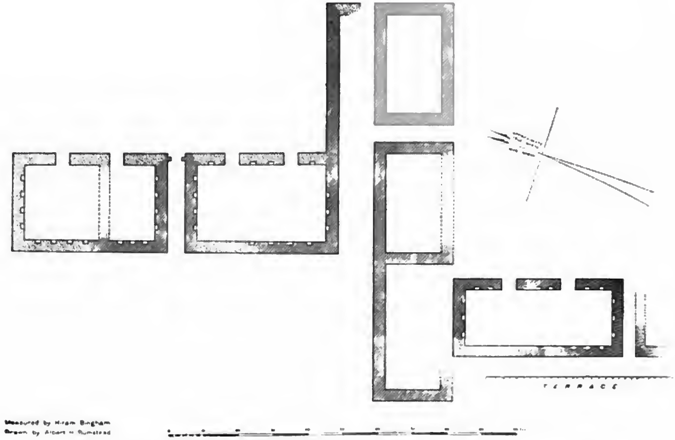
CCORIHUAYRACHINA

The ruins of Ccorihuayrachina, in the Urubamba Valley, are very primitive and were visited for the first time in 1912. Inside of one of the houses here shown is a solitary square projecting stone, the only thing that differentiates these ruins from many others.

Photo by Hiram Bingham

ANOTHER GROUP OF RELATIVELY UNIMPORTANT RUINS VISITED FOR THE FIRST TIME IN 1912 WAS AT LLACTA PATA IN THE AOBAMBA VALLEY

Corners of two of the smaller houses are shown in this picture as well as the type of tent used by most of our parties. It has only a single pole and may be easily put up by one man in five minutes (see text, page 534).



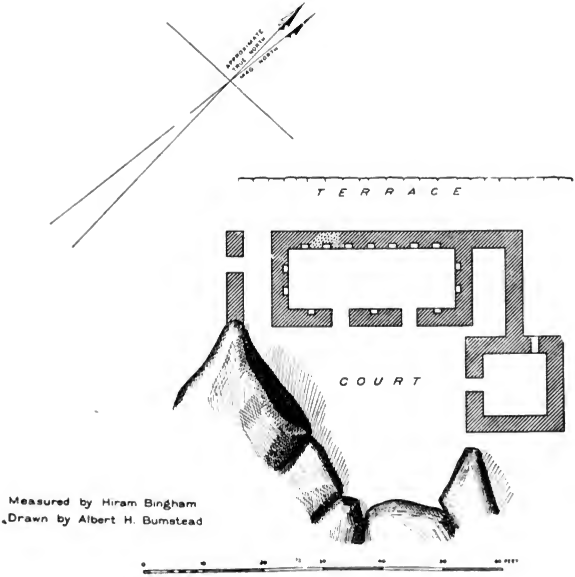
PLAN OF THE RUINS OF LLACTA PATA NEAR HUADQUIÑA, DISCOVERED BY HIRAM BINGHAM IN 1912

This plan shows the more important group of ruins at Llacta Pata, but does not show any part of those illustrated in the preceding picture. As in all Inca ruins, the marked characteristic is the symmetrical arrangement of niches within oblong buildings (see also text, page 534).

Photo by Hiram Bingham

ESTANCIA IN PALCAY

The most important group of ruins discovered in 1912 was that at Palcay, a hitherto unreported locality, where I found an extraordinary square fortified stronghold resembling in architectural details the ruins of Choqquequirau, described in my "Across South America," Chapter XXIII (see text, page 535, and plan, page 559).



RUINS OF ESTANCIA IN PALCAY

This ruin of a small isolated group of buildings at Palcay probably represents a temple and the residence of the priest. The presence of huge rocks, the careful character of the construction, and the absence of other buildings all point to this conclusion.

the knife edge of ravines, hoping that the city would come into view, and always disappointed.

"By noon we had come to where the ridge merged into the mountain proper and were working along its sides. After the stop for lunch the men refused to go any farther. They said if they did it would be merely to die of thirst; that the city of Choqquequirau was non-existent, and that they did not wish to die just because I did.

EXTREME MEASURES BECOME NECESSARY.

"I knew we couldn't make them work, but I thought we could force them to travel. Giving the 22 to Tomás, I told him to shoot any man who tried to bolt, but to do it carefully, around the edges. Then, taking a machete, I started ahead, cutting the way, and told them to follow. As Tomás stood between them and the back trail, they decided to do so, and for two hours we went ahead in that way. By that time I was just about exhausted, as we were working through thick cane and I was going at top speed.*

"Coming out on a little shoulder, I thought I saw some ruins on the next spur ahead. Looking through my glass

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* It should not be forgotten that all this time Mr. Heald was suffering from the effects of his accident on Huayna Picchu, which had partially disabled his right arm (pp. 431, 438).

Photo by Hiram Bingham

A CORNER OF THE RUINS OF LLACTA IN PALCAY

Showing a niche and a projecting cylindrical stone, and the chief Indian guide, who deserted with his fellows two days' later and left us in the lurch.

confirmed it. Then I pointed them out to the men. They too saw them, and after that there was no trouble. They were as anxious to get there as I was, for we were all suffering from thirst, and I had told them there was a spring there.

"Two hours of hard work placed us on the spur, though still high above the ruins. From there we could see several stone houses and two thatched huts, which had been left by the treasure-hunters who had come from Abancay two years previously. Just at dark we reached these huts. They showed signs of the old occupancy. There were two or three skulls lying around. A table-stone or two were in evidence and in one corner was an old Inca pot.

". . . While four of us were fixing camp I sent the other two out to look for water. In an hour they came back with the news that there was none to be found. By this time we were all very thirsty, but there was nothing to do but grin and bear it.

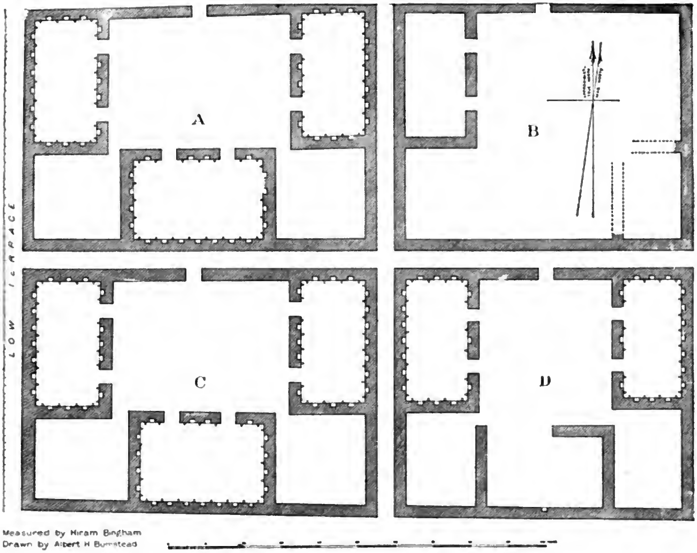
WATER HARD TO FIND

"About midnight I was wakened by a man crying and pleading. It was Tomás, who was having a nightmare. This in itself would not have been serious, but it excited the superstitions of the peons. They said the Incas were angry because we were there, and they wanted to be gone at daylight. I thought it best to spend some time making a search for the spring; so, as soon as it was light, we started and for an hour hunted in the jungle, but without result. The best we could do was to get water from air plants and chew certain bulbs which contained much moisture. This was not such a small help as it might seem, for many of the air plants had a good swallow of water in them, though of course we got it drop by drop at a time.

"Giving up hopes of finding a spring near the city, we took the back trail. We were all pretty weak, but we made very fair time. Reaching the ridge, we climbed down by a new way, marking our trail with piles of stones, and also followed a new trail back to the draw in which the spring was, striking the draw a good deal higher up. This turned out to be a better road; also it led us to the discovery of a series of stone-faced terraces, and at one point in them the spring broke through, so that with a little fixing we could get all the water we wanted, and that was a good deal."

They later found water within an hour's walk of Choqquequirau, and had a plentiful supply for the work of excavating as long as their provisions lasted.

They had hoped to accomplish a good deal of map-work, but, owing to the great amount of rain and the almost continuous prevalence of fog and mist, little could be done besides making a route map.



Measured by Hiram Bingham
Drawn by Albert H Bumstead

PLANS OF THE RUINS OF LLACTA IN PALCAY DISCOVERED IN 1912

The most remarkable feature of this fortified stronghold is that the cross-streets represent as nearly the exact cardinal points as it was possible for men working with crude tools to effect. These ruins are in the Southern Hemisphere, so the North Star is not visible. The ancient Peruvians did not know the use of the compass, and if they had the buildings would have been arranged according to the magnetic north and not according to true north. So exactly do the streets follow the local meridian and parallel that the exact orientation can hardly be said to be an accident (see pages 535 and 537).

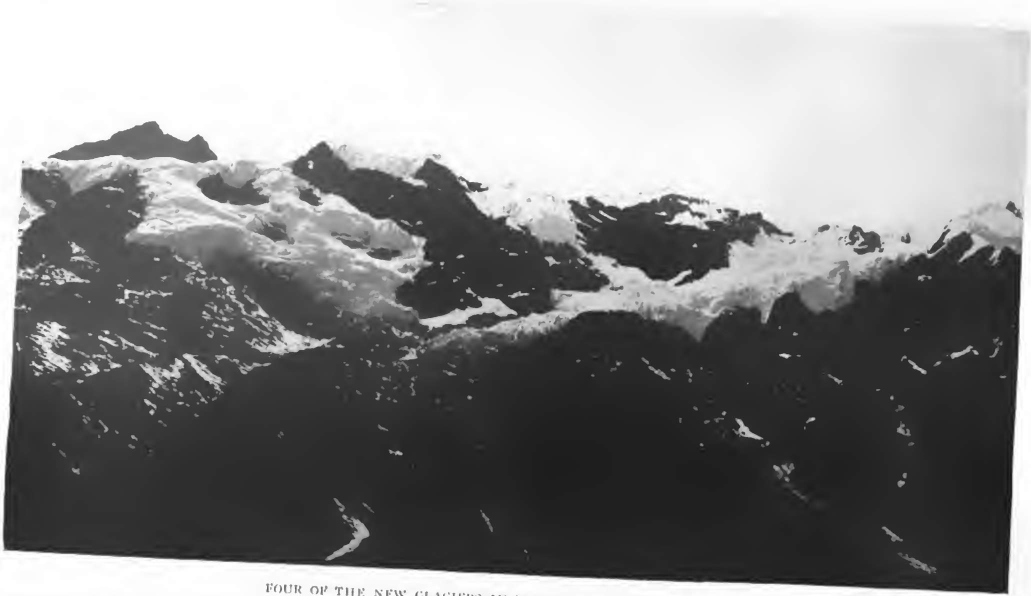
ACCIDENTS AMONG THE INDIANS.

The Indians suffered quite as much as the white men on this journey. One of the bearers, who was carrying a food-box weighing 60 pounds, slipped on a steep bank and fell 20 feet; the box, which fell with him, opened his head. The man was not killed, but of course had to be sent home, and as laborers were extremely scarce, his presence was seriously missed.

Another Indian ran a stick into his foot and blood-poisoning ensued. A third slipped off a precipitous rock and fortunately was saved by the rope which had been tied to his waist when passing this dangerous part of the trail, although he had a toe-nail torn off and suffered considerably from blood-poisoning.

The results of these hardships were the route map—the first ever made of this section of the Andes—the discovery of a number of hitherto unknown Inca engineering works, including ditches and agricultural terraces, now buried deep in the jungle and practically inaccessible, and a few boxes of archeological and osteological specimens.

Because of the scarcity of labor, the terror of the Indians, and the small quantity of provisions that could be carried over the extremely difficult trail, the party was only able to spend five days at Choq-



FOUR OF THE NEW GLACIERS IN THE UPPER AOBAMBA VALLEY

Photo by Hiram Bingham

Discovered on the 1912 expedition and named as follows, reading from right to left: Gannett Glacier, Grosvenor Glacier, Bryce Glacier, and Hadley Glacier (see pages 539, 541, 563-565) quequirau. Under Dr. Eaton's direction 11 graves were examined and such skeletal material and pottery collected as four men could carry on their return march. No metal objects were found in these graves.

The method of burial was similar to that observed at Machu Picchu, except that the construction of bottle-necked graves was far superior at Choqquequirau, and this style of grave apparently more in vogue than at Machu Picchu. It may be noted here as significant that apparently the best example of the bottle-necked grave at Machu Picchu was found in a house closely resembling in its architectural details the buildings at Choqquequirau.

This route had only been used three times previously: (1) by the French explorer Sartiges in 1834, (2) by the Peruvian explorer Samanez in 1861, and (3) by the Almanza brothers in 1885. It was used successfully this year for the first time since 1885. Great credit is due Mr. Heald for his courage and perseverance.

VIII

ANTHROPOLOGICAL STUDIES.

The anthropological study consisted chiefly in the taking, with extreme care and marked regard for scientific accuracy, of a number of anthropometric measurements.

The blanks used for the measurements were prepared by Dr. H. B. Ferris, of the Yale Medical School, and the results and photographs have been turned over to him for the preparation of a report on the anatomical characteristics of the Mountain Indians of Southern Peru as represented in the data obtained by the expedition.

Owing to the habit that the Mountain Indians have of frequently visiting Cuzco, the principal center of population, we were enabled to secure measurements of representatives of many villages and towns that we did not visit. Besides Cuzco, anthropological measurements were taken in Huadquiña, Machu Picchu, and Santa Ana.

At Machu Picchu we had our own workmen to draw on, while at Santa Ana and Huadquiña the managers of the large sugar plantations kindly placed their laborers at our disposal. In Cuzco it was necessary to employ force. Had it not been for the willingness of the Peruvian government to assist us, we should have failed in our object.

The method followed was to have the officer or soldier who was assigned to us go out on the streets and arrest any Indians that seemed to be of pure blood and who proclaimed by their costumes and general appearance that they were typical Mountain Indians.

On being arrested, the unfortunate subjects were brought to the doctor's room at the hotel. Many of the Indians thought that they were being recruited for service in the army, and not a few shed tears at the thought; others were only curious. All were much relieved when they were set free and given a five-cent piece with which to buy *chicha* (native beer made from maize).

Thirty-eight measurements were taken of each subject—measurements of head, face, ears, and nose, as well as of height standing, kneeling, sitting, and others. Many other data were also recorded concerning any peculiarities or deformations, color of eyes and hair, and other facts of anthropological interest.

One hundred and forty-five Indians were thus studied, and a front and side view photograph taken of each. They represented 16 provinces and 60 towns. Most of these were men. Photographs of many Indian women were also taken in Cuzco and at the stations between Cuzco and Mollendo, making 433 photographs in all taken for this study.

Some of the Indians were greatly frightened at the procedure. To one aged Indian military honors appealed, and he took his measurements with a smiling face. Another Indian, when he found he could have his picture taken free, dressed in his Sunday clothes. The next day he returned to see the photograph. When he was shown the negative he refused to believe that it was his picture, because he couldn't see the colors and the spangles that decorated that Sunday coat he wore.

CONCLUSIONS REACHED FROM THE MEASUREMENTS AND EXAMINATIONS.

At Huadquiña the Indians were ordered to a room to be measured. One subject objected strenuously and made it as difficult as he could for any measurements to be taken. He would not stand straight, nor sit straight, nor assume any position correctly. Finally, when the measurements were all taken, he was offered the usual *medio* for his trouble. This small coin, with which one could purchase a large drink of native beer, was usually gratefully accepted as a *quid pro quo*, but in this case the Indian decided he had been grievously insulted, and he threw the coin violently to the ground and strode off in high dudgeon.

Remarkably few cranial deformations were found, these being all slightly acrocephalic. The following facts were noticed about the Indians: The leg and back muscles are markedly developed, while their arm muscles show very meager development; their work consists largely of carrying heavy loads upon their backs over mountain trails; the Indians do not become bald, and their hair seldom loses its pigment; their teeth are also remarkably well preserved, except on the sugar plantations, where they suck the sugarcane and eat coarse brown sugar (*chancaca*).

An interesting custom which still prevails was observed as being practiced about two miles outside of Cuzco, as one goes north toward the Urubamba Valley. At a point in the road where one gets a last look at the city the Indians have a praying place.

THE INDIAN PRAYING PLACE ABOVE CUZCO

This road is one of the principal highways in Peru, and hundreds of Indians pass up and down going in and out of Cuzco daily. The view of Cuzco lying below in the green valley is truly a beautiful one, but it is something more than a sense of beauty that makes the Indians stop, and, with uncovered heads, some kneeling and some standing, offer a prayer as they look toward their Mecca.

It is noticeable that those who are on a journey going away from Cuzco pray for a longer time than those who are approaching the city. Possibly they fear the dangers of the roadside more than those of the city streets.

Another Indian custom which adds a picturesque touch to the roadsides between Cuzco and Machu Picchu is the presence of quaint signs indicating what is for sale in the Indian huts.

A small bunch of wheat or barley tied on the end of a pole and stuck out in front of the hut indicates that there is *chicha* (a native corn beer) for sale within. A bunch of flowers on the end of a pole also has the same significance.

A green wreath means that there is bread for sale, while a piece of white cloth or white paper waving in the breeze indicates that the wayfarer may here purchase *aguardiente*, a powerful white rum made of cane juice and containing a large percentage of raw alcohol.

It is sincerely to be regretted that more Indians could not have been measured, but as this work was entirely in charge of the surgeon of the expedition, Dr. L. T. Nelson, and as his first duty was to attend to the health of the members of the expedition, the anthropological measurements had to take second place. The exigencies of the work necessitated his spending a large part of his time where there was little opportunity for making anthropological measurements.

NO MEASUREMENTS PERMITTED IN AREQUIPA

In Arequipa he found that local sentiment prevented the government from assisting him. Arequipeños would resent any action compelling an Indian to submit to measurements, even though the subject were paid for his time. Furthermore, as practically the only pure-blooded Indians now in Arequipa are transients who come in for commercial purposes, driving their llama trains loaded with produce, the merchants of Arequipa would resent anything which might interfere with business. These difficulties made it impossible to secure any measurements in Arequipa.

On the trip to Choqquequirau, where the surgeon's presence was necessary,

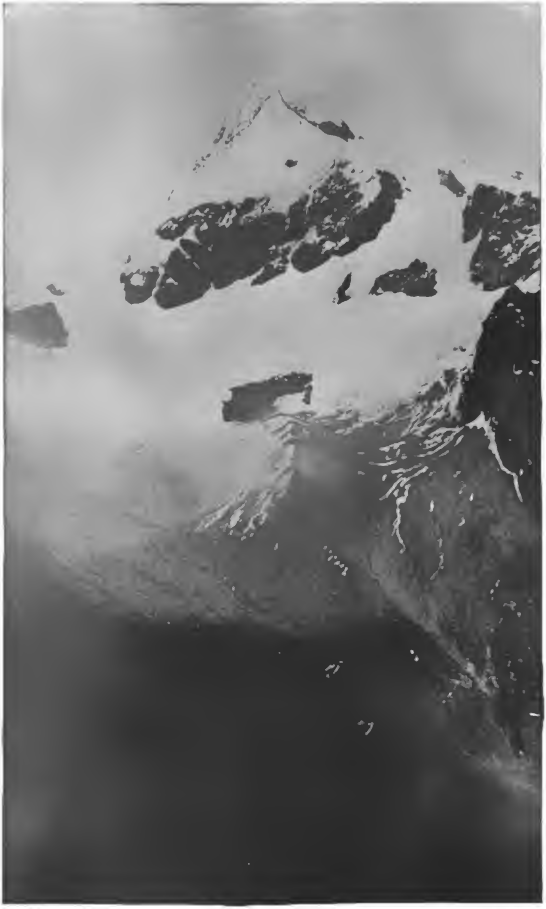


Photo by Hiram Bingham

MOUNT SALCANTAY AND THE YALE GLACIER AT THE HEAD OF THE AOBAMBA VALLEY

This peak, one of the most beautiful in the Andes, is probably 21,000 feet above sea-level, and has never been climbed or triangulated. It was cloud-covered so much of the time that we have hitherto been unable to triangulate it. Clouds may be seen gathering in front of the glacier, and two minutes after this picture was taken the entire mountain was enveloped in cloud, and nothing more than partial and fleeting glimpses were had of it during our stay in the vicinity (see pages 539, 541, 560, 564-565).

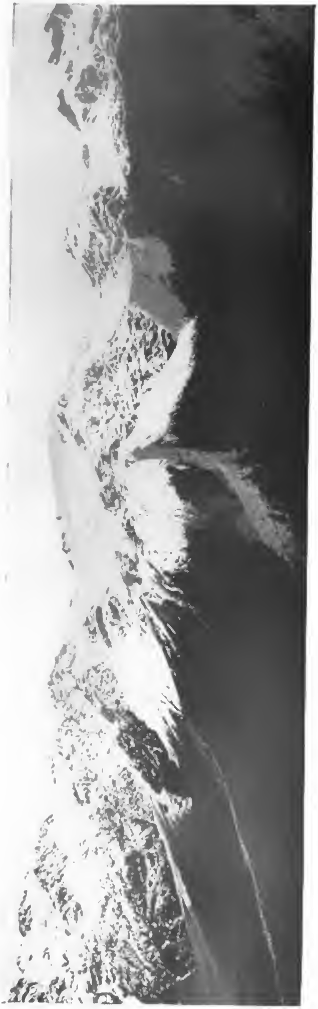


Photo by Hiram Bingham

SEVEN OF THE NEW GLACIERS DISCOVERED IN 1912 IN THE UPPER AOBAMBA VALLEY BY HIRAM BINGHAM

They have been named as follows, reading from right to left: Bryce Glacier, Hadley Glacier, Alfreda Mitchell Glacier, Harkness Glacier, Taft Glacier, Leguia Glacier, and Morkill Glacier. Bryce Glacier is on the summit at the extreme right. Taft Glacier is in the center of the picture

owing to the great risks of sending the members of the expedition over a dangerous mountain trail, it was necessary to cut the equipment down to any such surgical instruments as might be demanded, and it was not possible to take along any of the equipment for making anthropometric measurements.

Finally, owing to the presence of smallpox and an epidemic of typhoid in Arma, Puquiura, and the neighboring villages, the surgeon was obliged to stay with the topographical party all the time that they were working in that region. Their work was greatly hindered by adverse weather conditions, and so much valuable time was lost.

The extent of the smallpox and typhoid fever epidemics prohibited the surgeon from carrying on anthropological work there, on account of the danger of bringing the contagion to the camp. To be sure, the white members of the expedition had been vaccinated, both for smallpox and typhoid, by our medical adviser, Dr. H. S. Arnold, of the Yale Medical School, before leaving this country; but it would have been wrong to have had them run unnecessary risks or to have subjected to the danger of contagion the muleteers, engineering assistants, and the other native members of the party who had not been so vaccinated.

IX

WEATHER OBSERVATIONS

From May 28, the day of our departure from Panama, until the arrival of the vessel off the town of Mollendo, on June 8, a full series of weather observations was taken daily at the hours of 8 a. m., 12 m., and 8 p. m. The data recorded cover the following phenomena: Air temperature (dry-bulb thermometer), temperature by wet-bulb thermometer, barometric pressure, clouds, precipitation, wind, sea, and surface temperature of the ocean.

On the return voyage from Mollendo to Panama a full series of weather observations was taken similar to that recorded when outward bound.

A complete series of weather observations was taken at Machu Picchu and during the cross-section map-making. Arrangements were made with Mr. Burt Collins, the manager of the Inca Mining Company, and with Mr. Claude Barber, of the Santa Lucia mine, to undertake the establishment of four meteorological stations at widely different elevations along the 71st meridian west of Greenwich. One will be at an elevation of nearly 14,000 feet, another at an elevation of about 6,000 feet, another on the edge of the Great Plains, and still another on the River Madre de Dios.

Self-registering barometers, thermometers, and rain gauges have been supplied for these stations. Mercurial barometers and sling psychrometers have also been provided. Both Mr. Collins and Mr. Barber have agreed to look after the maintenance of the stations for a period of five years.

The instrumental equipment for these stations was in part a loan from the Harvard Observatory through the kindness of Prof. E. C. Pickering, and in part due to the generosity of Mrs. Alfred Mitchell, who placed at our disposal a special fund for the purchase of instruments.

The results of the work should prove most illuminating and ought to be of particular value in connection with the observations made some years ago by the Meteorological Department of the Harvard Astronomical Observatory at Arequipa.

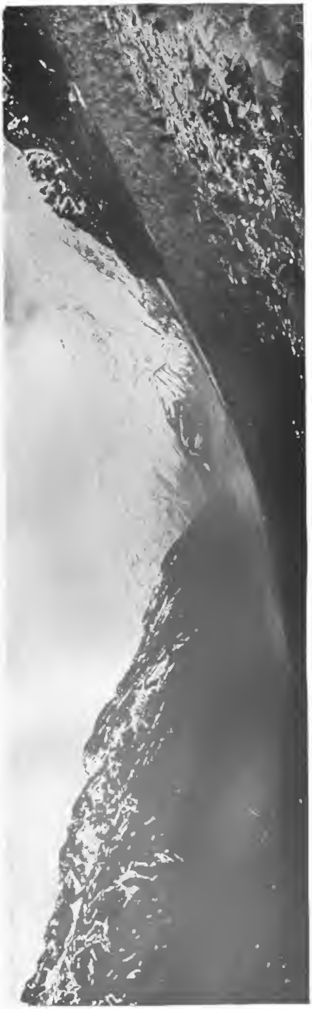


Photo by Hiram Bingham

ANOTHER VIEW OF THE NEW GLACIERS

Including, reading from left to right: Morkill Glacier, Leguia Glacier, Taft Glacier, and Harkness Glacier, looking down the Aobamba Valley from near the pass to the Chamana Valley (see pages 539, 541, 560, and 563)

Photo by Hiram Bingham

THE FIRST PETROGLYPHIC ROCK DISCOVERED NEAR CUZCO

At Maranyocc near Limatambo, on the trail from Mount Salcantay to Cuzco, a small boulder was discovered covered with petroglyphs. The right-hand figure is seated near the boulder (see text, page 544).

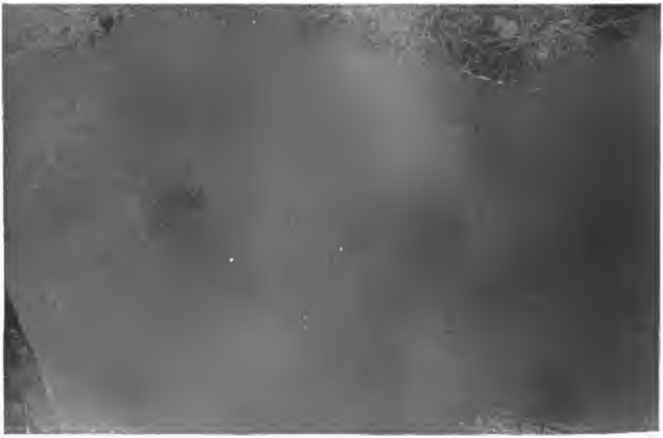


Photo by Hiram Bingham

A NEARER VIEW OF THE PETROGLYPHS NEAR LIMATAMBO

A partial view of the Maranyocc boulder covered with petroglyphs. Their significance is not known, and there is no tradition in the vicinity to account for their presence here. The picture was taken by arranging the tripod so that the camera pointed almost directly down. It is barely possible that this rock, which is carved in a manner unlike any other hitherto found in the Department of Cuzco, represents the story of an Indian raid from the jungles of the Amazon into the heart of the land of the Incas.

X

COLLECTIONS MADE BY THE EXPEDITION

Our collections have all safely reached New Haven. They consist in large part of the bones of the people who built and lived in Machu Picchu, of the potsherds, pots, and bronzes found there, and of the geological, osteological, and paleontological material collected in the vicinity of Cuzco, of geological specimens from other parts of Peru, and of 2,500 photographs taken with the 3A Special and No. 4 Panaram Kodaks.

In a broad geographical sense the results of Dr. Eaton's collecting is one of the most important and interesting features of the expedition. In the vicinity of Cuzco Dr. Eaton secured the skeletons of probably 20 individuals. At Machu Picchu more than 60 individuals were excavated, and at Choqquequirau ten.

With these ancient denizens of southern Peru were found a number of bronze metal objects, including pins, knives, forceps, and some very attractive pieces of pottery. Although Dr. Eaton was technically the osteologist of the expedition, his work lay in a variety of fields.

Invertebrate fossils were collected from the hills overlooking the town of Payta, Peru, and the site of an ancient cemetery at Pascasmayo was visited.

Vertebrate fossils were obtained from sedimentary gravels in the Huancaro Quebrada.

Photo by L. T. Nelson

THE SAN FRANCISCO PLAZA: CUZCO

A corner of the Cuzco market, showing venders of vegetables and fire-wood. Dr. Nelson, the surgeon of the expedition, took many photographs of men and women in the market-place and on the streets of Cuzco (see text, pages 561, 562).

ACKNOWLEDGMENTS

Acknowledgments are due to the United States government for kind offices in connection with securing requisite privileges in Peru and for the loan, on the part of the Army, of a detached service chest, which enabled us to have the use of an abundant supply of medicines and of a complete set of surgical instruments:

To the Peruvian government for many favors and courtesies, including the free entry of all our equipment and supplies, the assignment to our party of members of the Army whenever necessary, and the permission to bring all of our collections to this country.

To Mr. W. L. Morkill and the other officials of the Peruvian corporation and the Southern Railway of Peru for many courtesies, including the free use of their railway and telegraph lines.

To the President and Faculty of the University of Cuzco, who aided us in numerous ways and whose many courtesies included not only hospitable entertainment at houses of the professors, but assistance in finding interesting

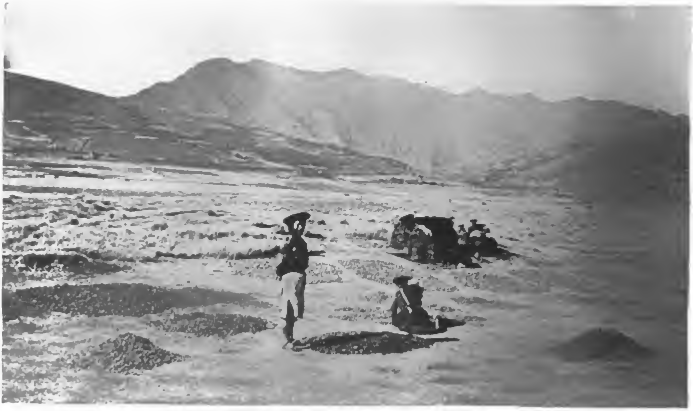


Photo by Hiram Bingham.

A FAVORITE SPOT FOR FREEZING POTATOES: NEAR CHINCHEROS

One of the commonest vegetables sold in the market-place is called *"chuñu,"* potatoes dried in the sun by day, frozen at night on selected spots of the high plateau, and pressed the next morning by the feet of hard-working Indians

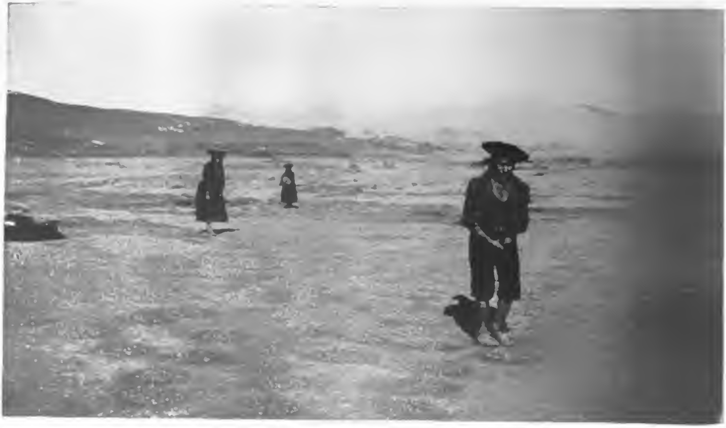


Photo by Hiram Bingham

SQUEEZING THE JUICE OUT OF THAWING POTATOES

A *"chuñu"* maker treading the juice out of the piles of little potatoes that were spread out at night and frozen. Potatoes so prepared keep well, but lose their flavor and are extremely insipid. The usual method of preparing them for the table is to grind them on a stone mortar and use the powdered *"chuñu"* to thicken soup.

Photo by Hiram Bingham

A ROADSIDE SCENE NEAR CHINCHEROS

Looking toward the Urubamba Valley from a point near Chincheros. There are almost no wire fences in this country, the place of barbed wire being taken by thorny hedge plants which include cacti, thorn bushes, and agaves, or century plants, as shown in the picture.

Photo by L. T. Nelson

THE ENGINEERS' CAMP NEAR PUQUIURA

Owing to the prevalence of an epidemic of smallpox and typhoid in Puquiura, one engineering party, that had the misfortune to lose its tent by fire, made its camp in a cave said by the natives to have been an Inca prison. It was not very comfortable, but it was dry and it was sanitary.

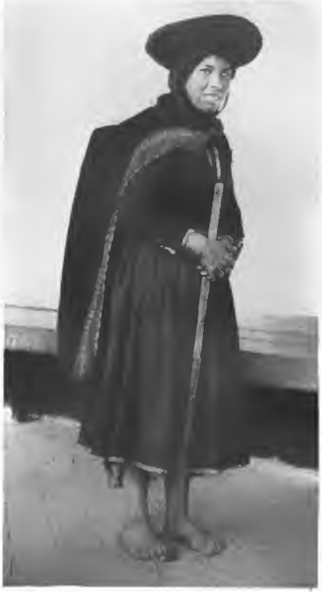


Photo by L. T. Nelson

A TYPICAL CUZCO GIRL

A pleasant-faced Cuzco Indian girl holding a yardstick to give an idea of her height, and wearing the regulation costume of the Peruvian Mountain Indian women. The hat is a flat pancake of straw lined on one side with red flannel, and on the other side with blue velveteen decorated with strips of gilt braid. It may be worn either side up, according to the weather.

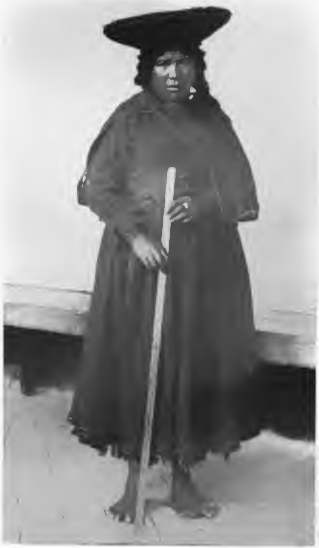


Photo by L. T. Nelson

ANOTHER QUICHUA WOMAN: CUZCO

Wearing the typical pancake hat, with the edges turned up, to denote that the weather is fine. The women in the Cuzco market-place form one of the most interesting sights for the average visitor.

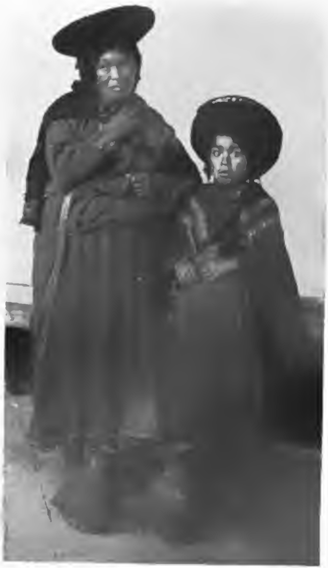


Photo by L. T. Nelson

TYPES OF INDIAN WOMEN IN THE CUZCO MARKET-PLACE

These are some of the Indians who were measured and photographed by the expedition (see pages 561, 562).

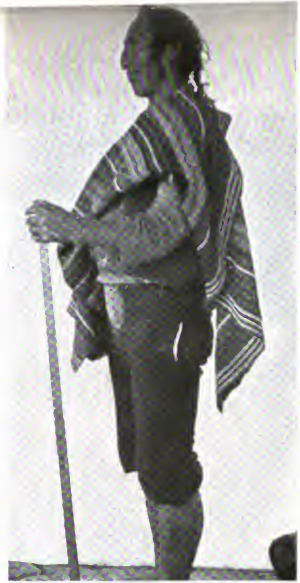


Photo by L. T. Nelson

"THE FATHER OF HIS COUNTRY"

About 150 Indian men were measured and photographed in an effort to get accurate information regarding their physiognomy and anatomy. Most of them were rather frightened, but this one, who has been dubbed the "father of his country," was very much flattered and highly pleased at having his picture taken (see text, pages 561, 562).

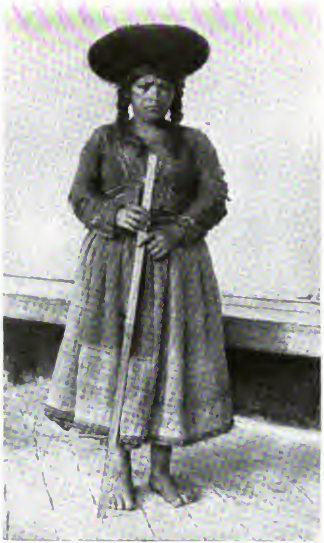


Photo by L. T. Nelson

QUICHUA GIRL: CUZCO

The Cuzco Indian women rarely speak anything but Quichua, the language of the Incas.

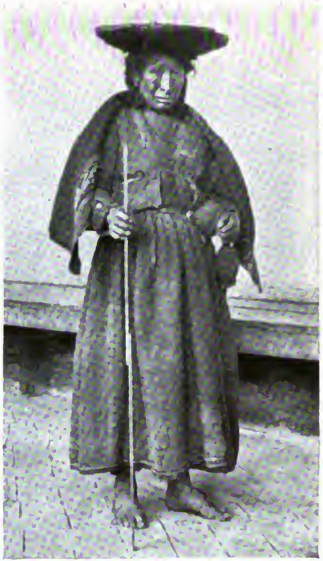


Photo by L. T. Nelson

A TYPICAL OLD INDIAN WOMAN IN CUZCO

An old Indian woman from the Cuzco market-place quite disgusted with the proceedings and wishing that her spinning had not been interrupted. In her left hand she is holding her yarn and primitive spindle.

Photo by Hiram Bingham

SHEEP AND A LITTLE MOUNTAIN SHEPHERD NEAR CHINCHEROS

The little Quichua boys early learn their duties as shepherds and spend many of the years when they ought to be at school in tending the flocks of their parents

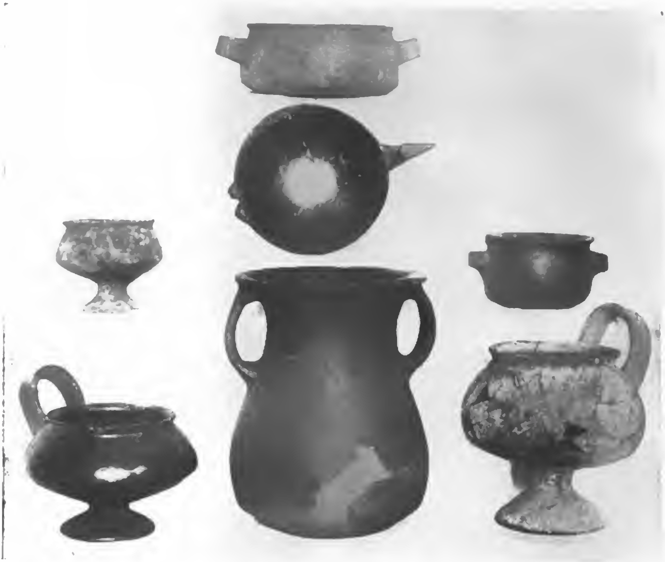


Photo by Hiram Bingham

POTTERY FROM MACHU PICCHU (SEE PAGES 446 TO 449)

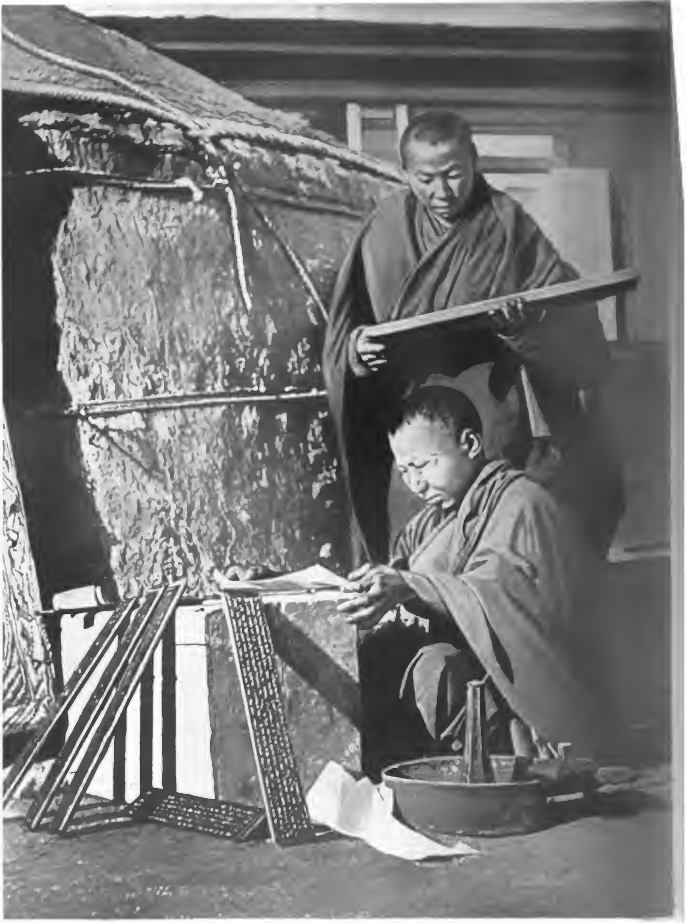
points whose whereabouts was not generally known.

To Messrs. Cesar Lomellini & Co., of Cuzco, who for two years have acted as our agents and have placed at our disposal their excellent facilities for handling the difficult situations which arise in connection with the organization and administration of an exploring expedition, and all without charging us any commission or any rent, although we occupied a large room in their warehouses as our headquarters for many months.

To Messrs. W. R. Grace & Co., whose unique position in Peruvian commerce enable them to assist us in unnumbered ways, beginning with the procuring of our supplies and ending with the carrying home of some of our collections in their steamers, without charge for any of their services. It is not too much to say that the work of the last two years could not have been accomplished as it has been without the continual friendly offices of this company, whose enlightened policy in regard to assisting scientific endeavor might well serve as an example to other companies engaged in carrying on foreign trade.

In conclusion it gives me great pleasure to acknowledge a large debt of gratitude to the officials of Yale University and of the National Geographic Society for their sympathetic coöperation during both the preparation and the progress of the expedition.

To them and to the members of the expedition I should like to take this opportunity to express my own personal thanks for the loyal support which has been accorded me from the beginning. The end is not yet, for it will take many months of patient and laborious effort to bring out the ultimate scientific results of the Peruvian Expedition of 1912.



BUDDHIST MONKS PRINTING

The art of printing is, in the West, a comparatively recent discovery, but in China and some other parts of the East it has been known for ages. In many of the monasteries of Tibet and Siberia the Buddhist monks still print in the manner which has been handed down from generation to generation. Movable type is not used, but each page is carved upon a solid wood block, and thus, whenever a new book is printed, entirely new blocks have to be made. Several of these blocks can be seen in the picture, and from them the shape of a Tibetan book can be easily imagined. The printing press is an enormous stone which has to be raised and lowered by hand as each sheet is printed, and the production of a book is consequently a process requiring much time and labor.

/ASHINGTON MAY, 1913

THE
TIONAL
GRAPHIC
GAZINE

S OF OUR BACK YARDS

)AVID FAIRCHILD

AND PLANT INTRODUCTION, DEPARTMENT OF
AGRICULTURE

*s," "New Plant Immigrants," and "Madeira, On
the National Geographic Magazine*

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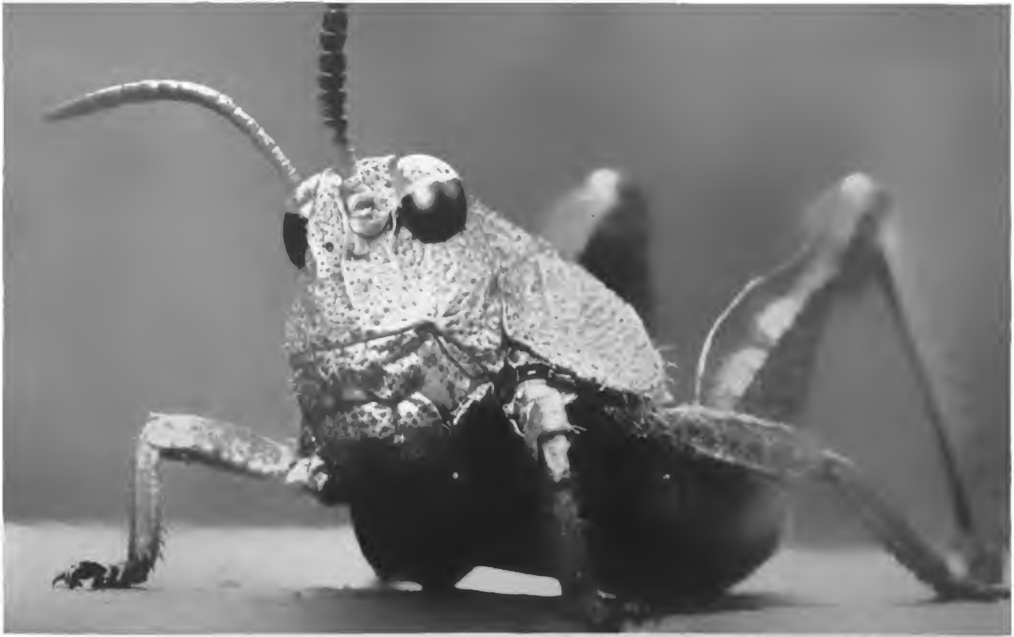
of them that I really began to look into the vast storehouses of literature which describe the life histories of these creatures.

The facts which I have been able to find out about them represent not my own observations, but those of hundreds of trained observers who, working quietly for years and some of them for a lifetime, have studied out the habits of these various forms, most of which are so difficult to study that months of patient waiting have been required to find out some significant fact about their ways of life.

I had thought, in my ignorance of the subject, that all of my beasts had names, for they were caught within a stone's throw of my house; but my entomological friends of the Department of Agriculture and of the National Museum found difficulty in identifying some which I thought must be common; and now, since I have read more fully of the vastness of the world which I had entered, I wonder that with only the mummified specimens which I had preserved they could name so many of them.

In fact, almost the first sentence in the first text-book I opened made the astonishing statement that "insects are the most numerous in species and individuals of all land animals. It is estimated that about 250,000 species have already been described and have had scientific names



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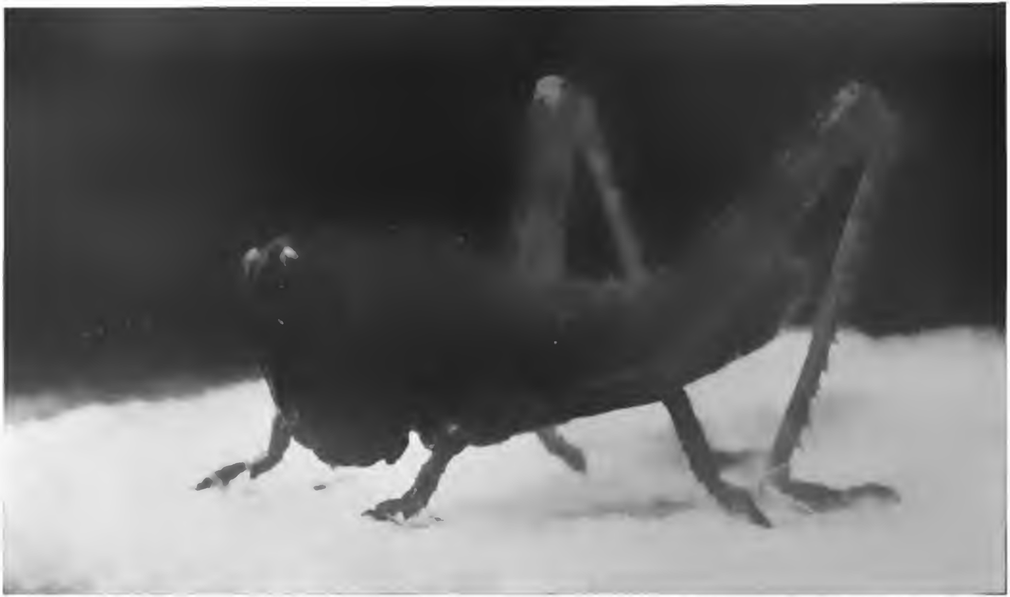
THE KING GRASSHOPPER

A representative of one of the great enemies of the human race. Down its broad throat can disappear with astonishing rapidity the green leaves which make the foods we most depend upon; and, in the past, famines which have cost the lives of thousands of human beings and consumed the fortunes of millions of them have been traced to the voraciousness of hordes of young grasshoppers like this (see page 579)



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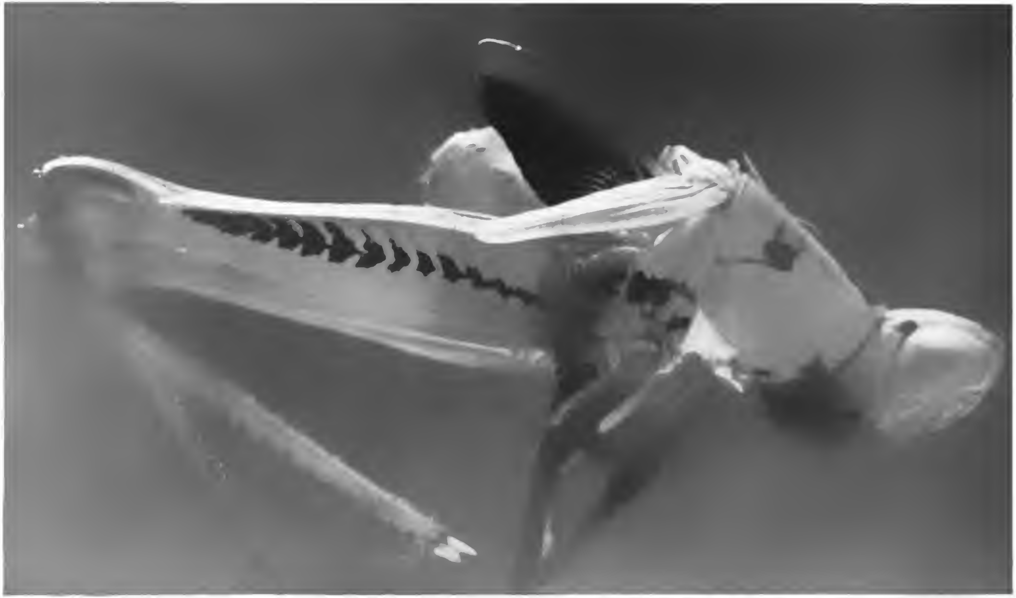
A BABY GRASSHOPPER

Unlike the beetles and the butterflies which spring full-fledged from the metamorphosis of a caterpillar, the grasshopper comes to be a winged creature by slow stages, each one a little more advanced than the former, with wings a little better developed. The baby grasshopper is essentially a small, wingless adult, and not a grub or larva in the ordinary sense (see page 579)



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A YOUNG GRASSHOPPER'S SKELETON

The grass of the back yard is strewn with such skeletons as this, for every single grasshopper leaves from five to seven of different sizes in the course of his life wherever he happens to be when a moult or change of skin overtakes him in his career. Like crabs and other crustaceans, the grasshoppers crawl out of their shells or skeletons whenever in their growth these become too small (see page 579) given to them, and it is considered that this is probably only one-tenth of those that really exist."

I must explain that all the creatures shown are not insects; for, strange as it may seem to some of my readers, spiders are not insects, for they have eight instead of six legs and no feelers or antennæ. It is a pleasure to present these monsters to the public as a showman might, on a level with the eye and not looking down on them as they are so often shown in text-books on entomology.

THE KING GRASSHOPPER (PAGE 576)

The young king grasshopper is probably 20 days old, and its wings have not developed, but it can jump a hundred times its length, whereas man can scarcely cover three times his length at a leap. When its wings grow and its internal air sacs fill with air it can sail away for miles. One representative of this great family can sail for a thousand miles before the wind, and they go in such numbers that they make a cloud 2,000 square miles in extent.

Its great front lip hides a pair of jaws as effective as a hay-chopper, and it has an appetite as voracious as that of a hippopotamus. This voraciousness and these jaws are what have made several of its relatives the plague of mankind. They multiply in such numbers as to baffle all calculation, and every living green thing for thousands of square miles disappears down their throats, leaving the country they infest desolate. The great famine of Egypt, mentioned in the book of Exodus; the grasshopper years of Kansas, which ruined thousands of families on our plains, and more recent devastations in Argentina and South Africa are examples of the tremendous effects which the migratory locusts have had upon the happiness of mankind.

As this young king grasshopper stands looking so inquiringly at one with his varicolored eyes, each of which is composed of hundreds of facets, I cannot help thinking that he represents a creature quite as fascinating and actually more dangerous than the East African monsters of our school geographies.

A BABY GRASSHOPPER (PAGE 577)

A baby creature, scarcely two weeks since it issued from a grasshopper egg, and yet with two moults behind it—two bright green baby skins cast off!

Imagine looking forward, as this baby creature does, to the day when the pads on its back shall have grown so long and parchment-like that it can leave its hopping terrestrial existence and sail away across the fields. Until that time, however, it must be content with its six springy legs, pushing its way among the blades of grass, tasting everything green and eating what it likes, and hiding from its enemies when moulting time comes round.

A young chick finds itself shut inside the egg-shell and must work its way out alone, but the young grasshoppers when they hatch out find themselves—the whole nestful—shut in a hardened case in the ground made by their mother, and it takes a half dozen of them working together to dislodge the lid which shuts them in.

YOUNG GRASSHOPPER'S SKELETON (PAGE 578)

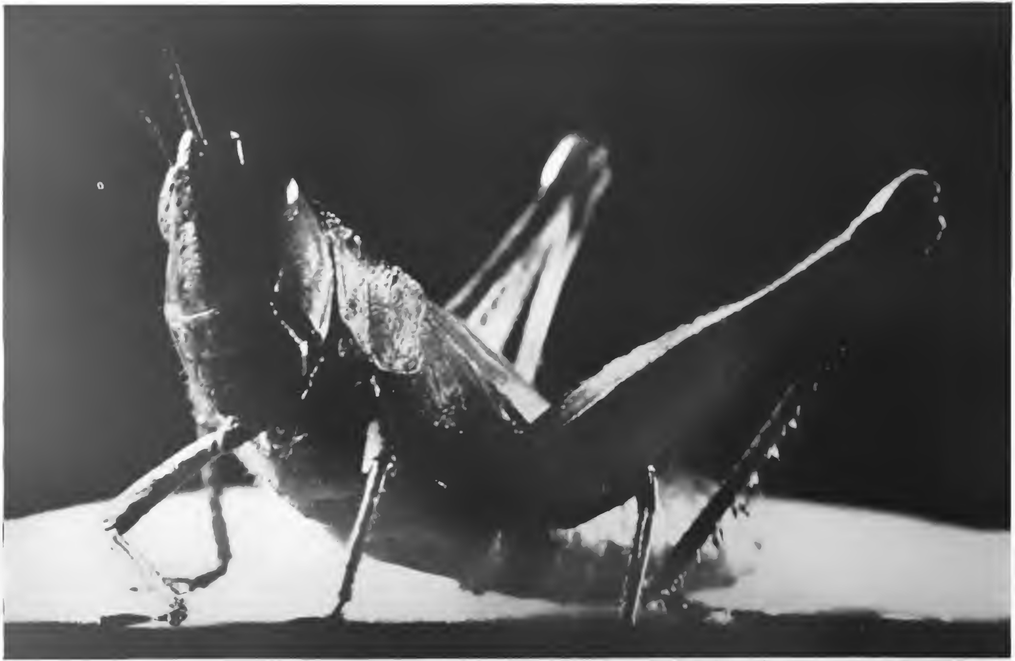
When the young grasshopper emerges from the egg, it is very small indeed—a wingless, helpless little creature, all legs and mouth.

It passes through successive ages, or stages, as they are called, each one of which is separated from the other by a moult or casting of its outer shell.

These moults take place at fixed periods, and as the insect finds itself restrained by its firm, inelastic skeleton, a longitudinal rent occurs along the back, and the insect, soft and dangerously helpless, struggles out of the old skin inclosed in a new but delicate cuticle, which takes some time to harden and color up.

Some people go to great trouble and expense to keep the baby portraits and even the baby shoes, and I cannot help wondering whether a full-grown grasshopper, leading a life in the open air, is ever interested in observing the baby skeletons which show its five stages of terrestrial life.

What an interesting collection could



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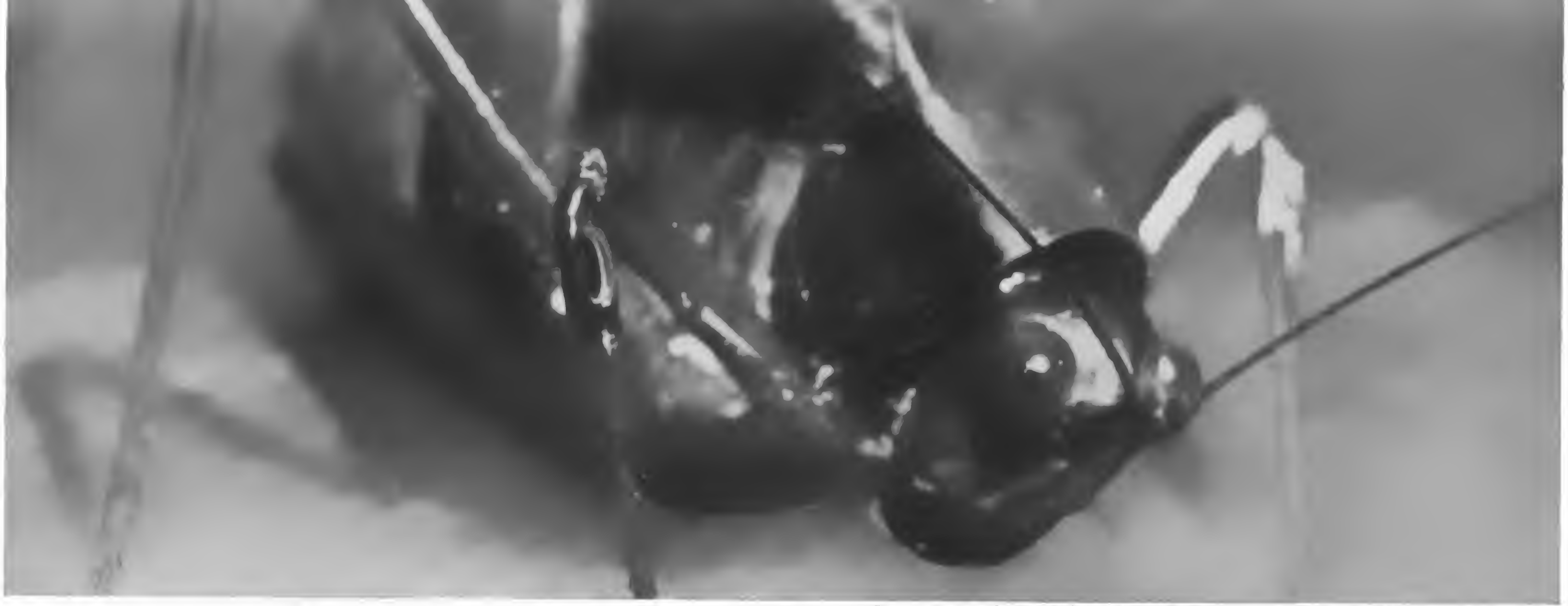
A GREEN GRASSHOPPER

For the first time in history, perhaps, we see face to face the portrait of this typical enemy of the human race, which is everywhere about us in the grass. If our jumping powers were equal to his, we could clear 600 feet at a leap (see page 583)



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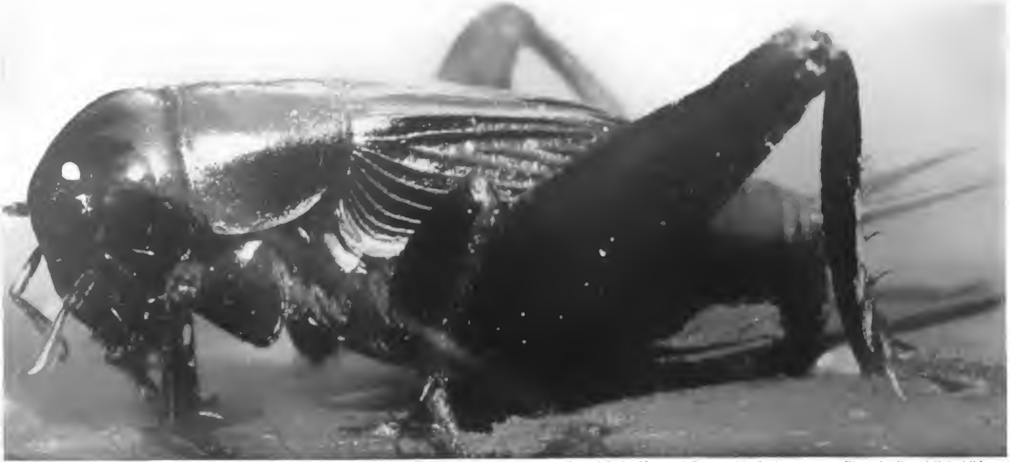
THE KATYDID

When the katydid begins its noisy summer singing, remember that it is the male calling to his mate and that she is listening with her ears, one in each front leg, just below the first knee-joint (see page 583)



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THE CRICKET ON THE HEARTH

It may be questioned whether this cricket of our firesides is not as old a member of the household of human beings as the domesticated cat or dog, and it is interesting to think that even the cave man may have listened to its chirpings in the light of his camp fire (see page 583) be made of these insects' skeletons, photographed large enough so that we could see and study them!

A GREEN GRASSHOPPER (*Dichromorpna viridis*), PAGE 580

Whether this creature has a personality or not may be forever extremely difficult for humans to decide. Its eyes that look like cows eyes really cast a thousand images on a special kind of brain, so different from our own that we cannot understand it, and then besides these great big eyes it has three others scarcely visible in the picture. Its short-ringed horns are not horns at all, but sense organs of so complicated a nature that we do not yet know certainly whether they are organs of smell or not, and it is supposed that they may be the seat of sense organs that we humans do not have.

In front of the great thighs embedded on each side of the body, but hidden in the picture by the second leg, are the so-called ears, tuned no doubt to catch vibrations of the air far too delicate or too frequent for our ears.

The jumping legs of the creature are filled with powerful muscles, which when they expand can hurl it through the air and enable it to escape from its enemies. On the inner side, along the lower rib of the wing, is the musical instrument. It is a row of hard, bead-like projections, which are very highly developed in the males, but not at all in the females. When the edge of the wing is scraped over these projections, a musical sound is made. It would seem to be the case, as with so many of the birds, that only the male can sing, the female being mute.

THE KATYDID (*Scudderia furcata*), PAGE 581

How marvelously equipped such a creature as this is to live! The great eyes, with many facets, enable it to see by night as well as by day. Its long, slender antennæ catch the faintest odor, and probably are sensitive to a host of perfumes that we do not know. In the front of each fore leg, just below the knee, is a dark sunken area, the ear, with which it can probably hear sounds too faint for our ears, and by moving them can tell from which direction the sounds come. Its long muscular legs enable it to jump great distances, and its wings not only enable it to fly well, but in the males are provided with an apparatus near their base for making a musical sound.

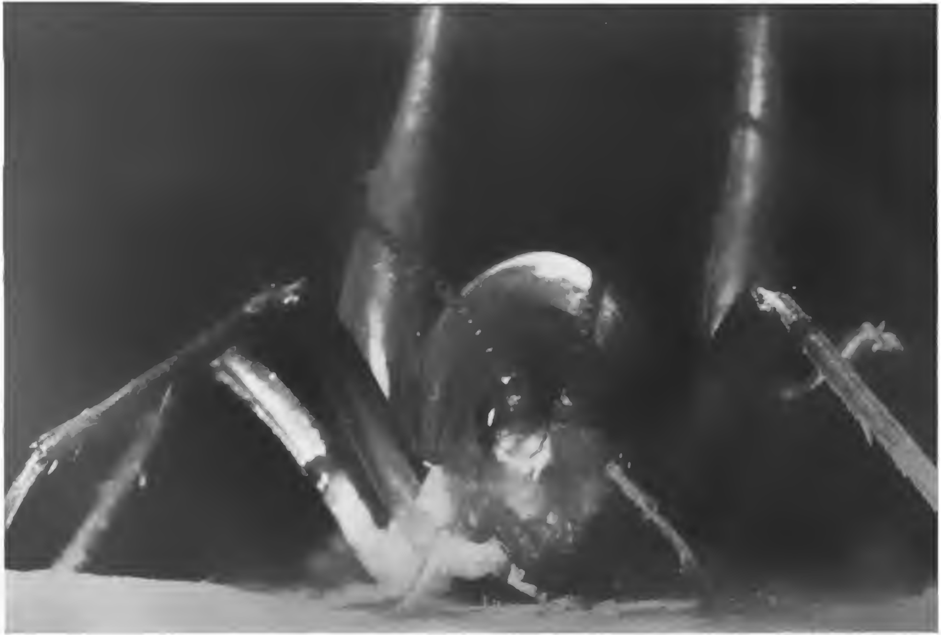
In fact, if it is any comfort for sleepless ones to know it, the katydid is one of the noisiest creatures of its size in the world. It is only the males which call their "Katy-did, Katy-didn't, she did, she didn't," and they are calling to their mates.

THE CRICKET ON THE HEARTH (*Gryllus Pennsylvanicus*), PAGE 582

Through the ages, who knows if not from the times of the cave dwellers, this friendly visitor of the fireside has rubbed his rough wings together over his head and sung man to sleep. The European form seems quite as domesticated as the cat or dog, leading nowhere a truly wild life, and it may be questioned whether any living creature has become more a part of human life than the cricket on the hearth.

The carrying power of their song is extraordinary; there are species whose strident notes can be heard for a mile, although their little bodies are scarcely more than an inch in length. The males alone are musical, and it is reasonable to suppose, since the females have ears in their fore legs, that they are singing to their mates and not to mankind.

As one listens to their friendly song it is hard to appreciate what fighters they are among themselves, the larger ones even turning cannibals when food is scarce, although a glance at the photograph shows how well equipped they are for battle. Their great black eyes only shinier black than their coal-black armored necks, their jointed palpi with which they feed themselves, their thick, leathery wings pressed against their sides like a box cover, and their strong, muscular spiny hind legs, with which they jump a hundred times their own length.



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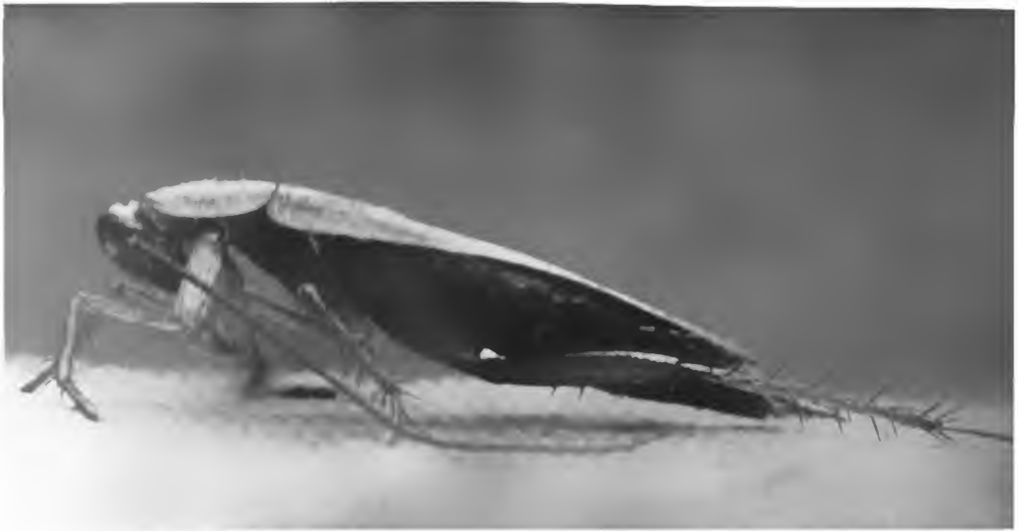
THE STONE OR CAMEL CRICKET

A tawny, long-legged creature of the night, with great dark eyes, which catch the faintest glimmer of light, and long antennæ, which feel in every direction. I wonder if it jumps at night as it does by day when you discover it under a decaying log. In reality it is about an inch long (see page 587).



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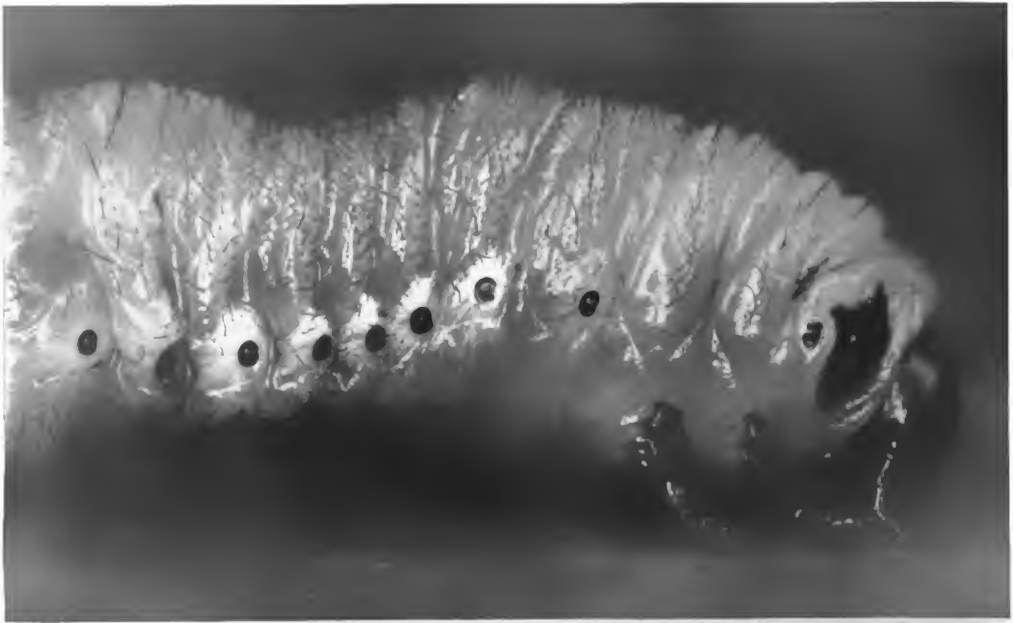
THE COCKROACH

The detestable night visitor of the kitchen whose presence is an indication that somewhere crumbs of food or grease or something of the kind is left about. No wonder, with such spiny legs as these, it can crawl anywhere and everywhere, and with hundred jointed feelers it is quick to scent the presence of its food. What diseases may it not bring into our houses? (see page 587).



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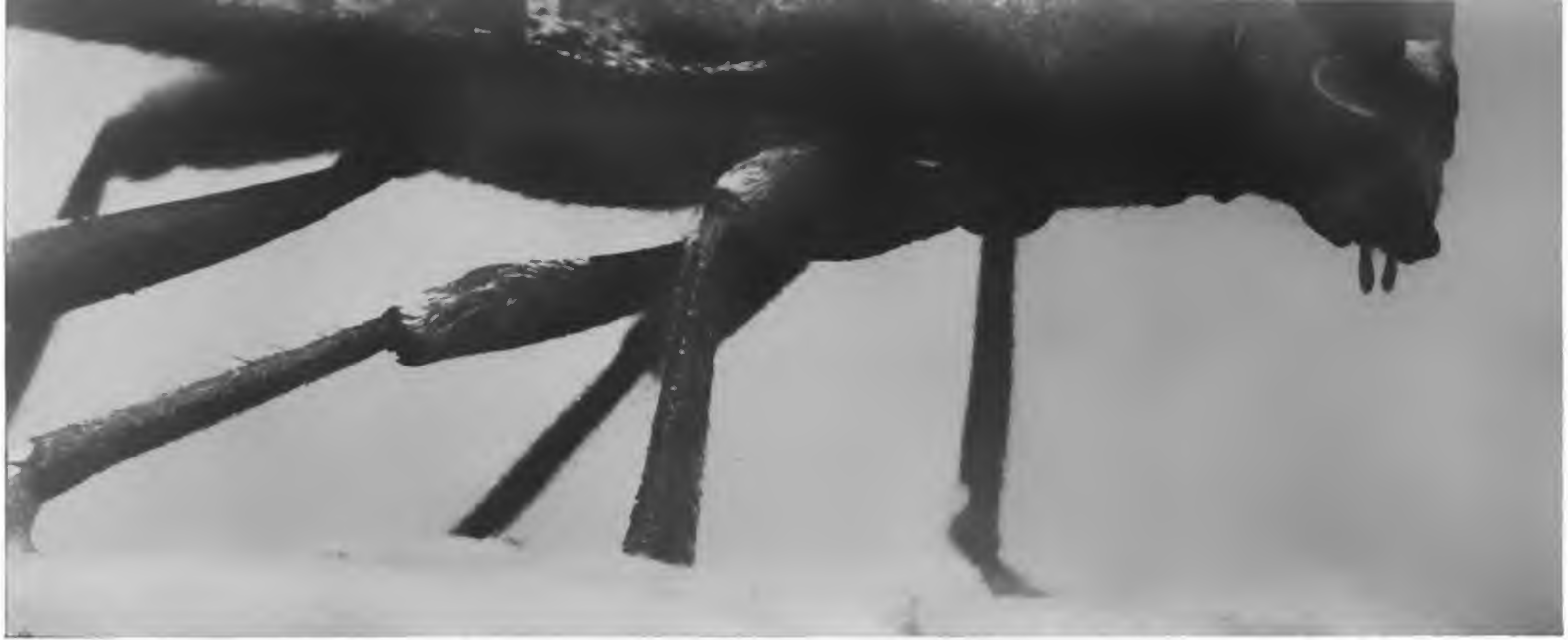
THE JUNE-BEETLE LARVA

This clumsy, helpless creature, with its rows of breathing pores and short functionless legs, has fattened for weeks like a pig on the leaves of trees, and is now nearing the stage when its internal organs will break down completely and certain active groups of cells will start to build up out of the material of the disintegrated ones the beautiful emerald green beetle (see page 591)



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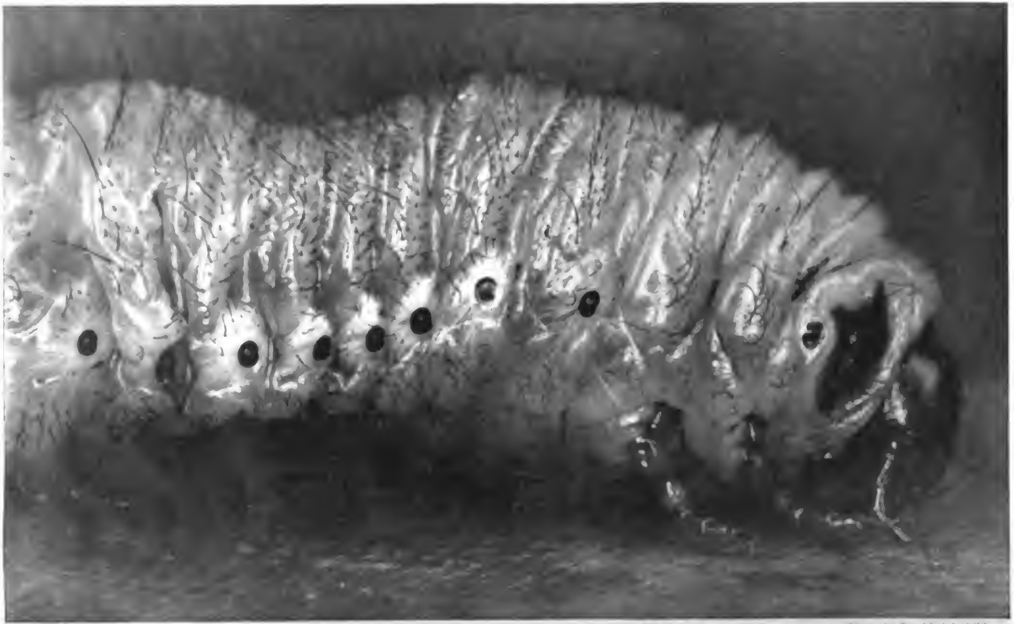
ONE OF THE TWIG-PRUNERS

Representative of a large group of beetles whose larval existence is as subject to the laws of instinct as falling bodies are to the laws of gravitation. They kill the twigs they burrow in and the wind blows them to the ground at the proper time for the larvæ to crawl into the ground and turn into the mature beetle (see page 595)



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THE JUNE BEETLE LARVA (*Allorhina nitida*), PAGE 588

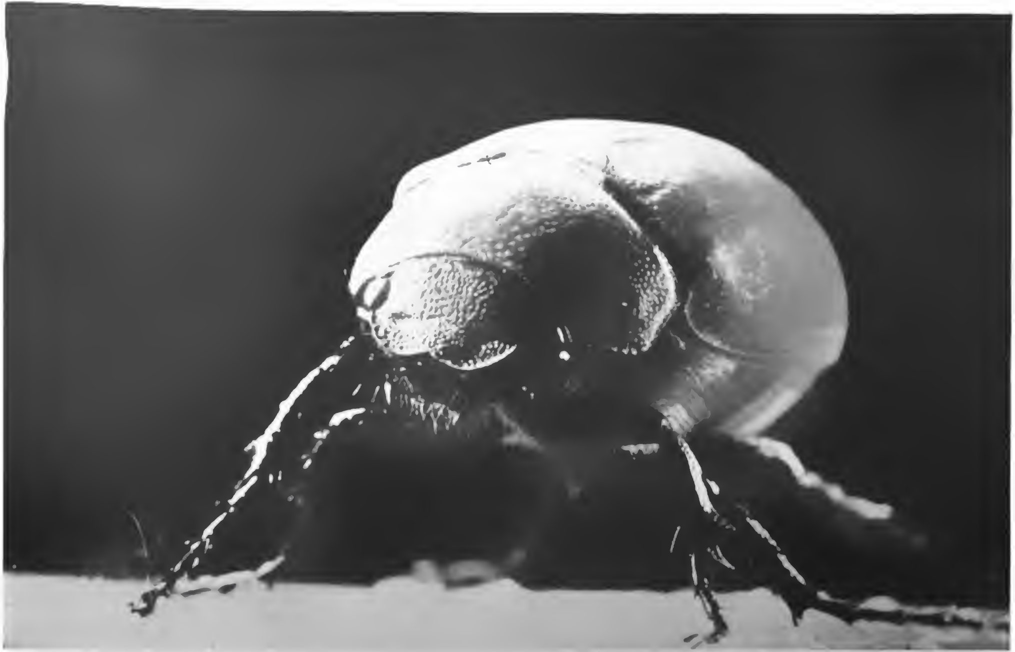
How is it possible that this fat creature, with eye-like breathing pores along its body, whose legs are worthless, and which is so helpless that it has to turn over on its back to wriggle over the ground, can change into the emerald-green June beetle which wings its way like an aërodrome across the meadow? This is the apparent miracle of metamorphosis which has well-nigh baffled the intellect of man to explain.

Though the reasons why are still unknown, modern research has shown us how this incredible change has taken place.

When this creature, which has grown a hundred times its size since it was born, has reached the age for this great change, it doubtless feels the impending transformation coming, and instinct tells it to crawl away into some protected nook or corner and pupate underneath the protection of a silken cover-lid of its own spinning.

The change begins; each organ goes to pieces, disintegrates, becomes a mass of disconnected cells, so that the body filled with these becomes, as it were, a bag of mush. This mushy fluid has been likened by entomologists to the disintegrated tissues which inflammation causes in our own bodies. If, then, you should slit it open at this stage, you would find no alimentary canal, no salivary glands, no muscles, simply a thick fluid, with here and there a thicker lump, that is attached at certain places to the inside of the sac wall. These lumps are formed of groups of active cells which were not disintegrated in the general breakdown of the muscle tissue, and these form the nuclei around which the new creature is to be built. These groups of cells grow rapidly, feeding on the fluid mass of broken-down tissue much as a young chick inside the egg feeds on the yolk, and builds up the whole complicated structure of the winged beetle, which seems to have no possible relation to the white grub out of whose body it was made.

It is as though the insect hatched twice, first from the almost microscopic



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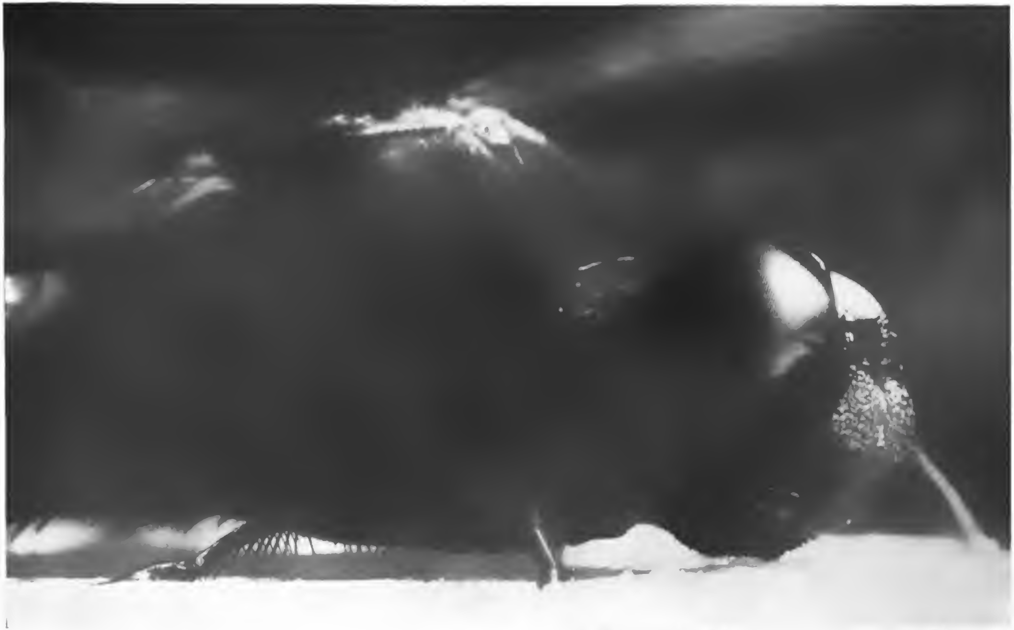
ONE OF THE JUNE-BUGS OR MAY BEETLES

The loud buzzing of this creature's wings and the sharp crack of its hard shell as it strikes the window pane at night in trying to get to the light are familiar sounds of spring. It is as strange to think that this beast was ever a white, worm-like grub as it would be to know that a hawk was developed from a mole (see page 595)



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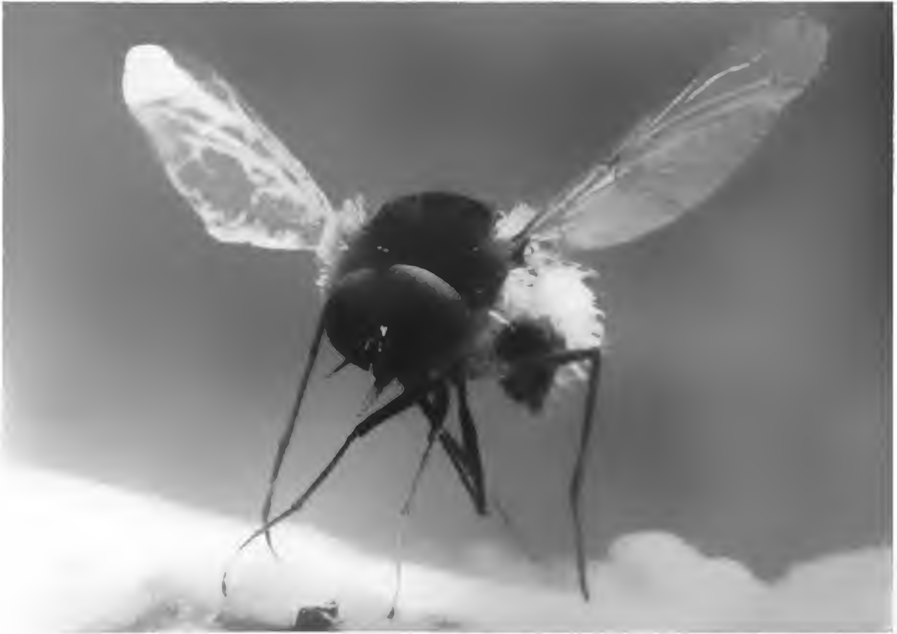
THE DRAGON-FLY

To the world of gnats and flies this dragon must be as terrible a monster as any which the mind of a Doré imagined. Two thousand facet eyes give it superb vision. Its wings, like supporting air-planes, propell it through the air with incredible speed. Its voracious jaws and powerful legs, armed with spines, all serve to make it the terror of our own plague—the mosquito (see page 597)



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ONE OF THE BEE-FLIES

As beautiful as any creature of the air can be, with velvet black body, fringed with golden hairs and diaphanous, iridescent wings and great gray eyes, which make up most of its head. In the winged state it feeds on nectar, but its larvæ lives inside some caterpillar. It is smaller than a house-fly (see page 597) egg its mother laid and from which it emerged as a tiny little creature in the image of this grub, growing and manufacturing from the leaves it eats enough nitrogenous matter so that when it emerges again from the yolk-like substance of its cocoon it will be a full-grown beetle, for it must be remembered that once made the beetle never grows.

This wonderful process is the same which is gone through by every flying insect that has a grub or caterpillar stage.

ONE OF THE TWIG-PRUNERS (*Elaphidion atomaricum*), PAGE 589

The long-horned beetles, as they are called, are remarkable for the length of their antennæ and their eyes of many facets, which almost encircle the antennæ at their base. They have, like other beetles, two lives, so to speak, and their grub-life is spent inside some twig or branch, burrowing and living on the juices which their stomachs extract from the sawdust made by their jaws. They kill the twig they burrow in, so that the wind blows it to the ground, and they go through their transformation on the ground. The story is told of a long-horned beetle, belonging to a different species, that lived for years in its larval stage, burrowing patiently into the dry wood of a boot-last or shoe-stretcher, trying vainly to get enough nourishment out of it to make a beetle of itself.

THE PREDACEOUS GROUND BEETLE (*Chlænius æstivus*), PAGE 590

This creature almost any one will recognize as a beetle. It is built for running, and its jaws are made for fighting. You have only to catch one and watch it open and shut its jaws to realize that it would bite you if it could. But for all that it is a great friend, for it is what the entomologists call predaceous, and at night or at twilight it hunts everywhere for the larvæ of insects which attack the plants we live on. In its larval state, in which it looks for all the world like a centiped without the "ped," it burrows in the ground in search of the plant destroyers, which think to escape notice by getting under the cover of the soil. They are by nature, then, opposed to the vegetarians, the herbivores, and hunt them wherever they are likely to occur.

When you see a black or dark-brown beetle running swiftly from under some stone or log which you have just turned over and which makes faces with its jaws as though it would chew your fingers when you pick it up, you can be quite sure in eight times out of ten that it is one of these carabidæ or predaceous ground beetles, and if you let it drop from your fingers you may be saving the life of a friend, because some day it may eat the worm which, lying close to some pet flower of yours, had planned to cut it off beneath the ground.

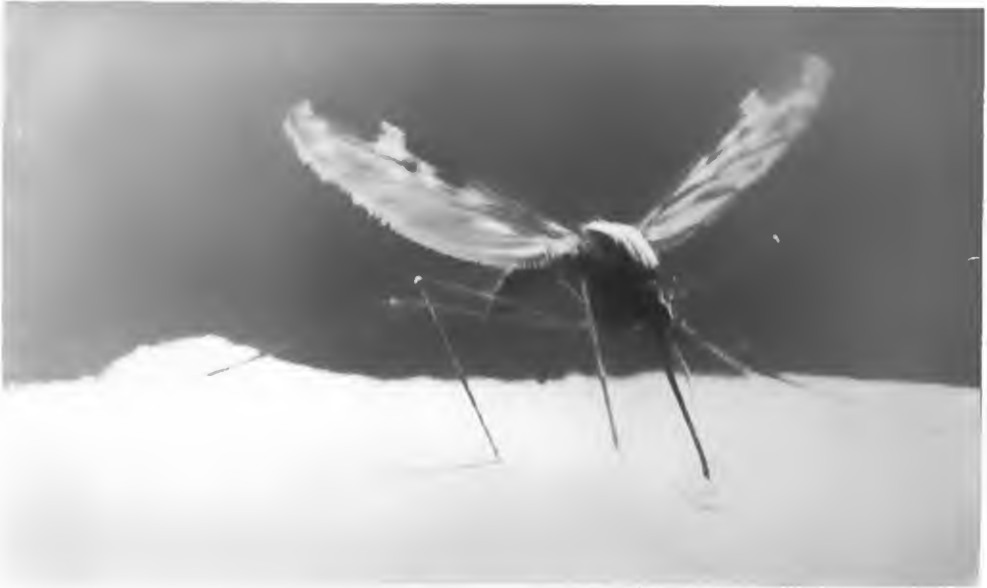
It is the hardest thing in all the world to understand how balanced is this scale of foe and friend. One year there is a wiping out of our insect friends through frost or floods or microscopic disease, and, freed thus from the check which kept their numbers down, the foes to our plants can multiply to such an extent that nothing we can do will save our crops from total failure. Next year perhaps the parasitic beetle, finding such a wealth of food to live upon, increases and holds well in check the pest which last year ate up all our plants. Each wave of insect pests could be explained, no doubt, if all the facts were known, and nowadays no one who knows what modern agriculture means will fail to reckon on the risks from losses caused by these pests.

ONE OF THE JUNE-BUGS OR MAY BEETLES (*Lachnosterna quercus*), PAGE 592

Of the wild creatures of our back yards, none is better known than this hard-shelled buzzing creature, which whirrs into the circle of light around your lamp and commits suicide, if you will let it, by flying into the flame.

It is one of the so-called June-bugs, or May beetles, which every boy and girl knows, and is not the June *beetle* of which the larva was shown previously.

Its hard, pitted skeleton covers it completely, and it is most interesting to watch it open its wing covers with great deliberation, unfold the wings which are carefully stowed away beneath them, and holding its wing covers elevated so they will not interfere, start the transparent



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ONE OF THE HARMLESS ANOPHELES MOSQUITOS

No conquest of science seems more wonderful in its simplicity and more remarkable in its importance than the discovery that the glands at the base of the mosquito's bill can become diseased and harbor a microscopic parasite, and make of this otherwise merely buzzing, annoying insect one of the most dangerous things alive (see page 597) wings into motion and fly away with the whirr of a miniature aërodrome. Indeed, it was this resemblance which caused the members of the aërial experiment association to name one of their first aërodromes after it, and the first trophy ever given for an aërodrome flight was won by Curtiss' "June Bug."

This creature's first life is spent beneath the sod of your lawn, where it curls up around the roots of the grasses and clover and other plants which you do not want it to eat, and the first year of its subterranean existence it is the white grub, with the brown head, which everybody knows. At the end of the second summer of its life it changes to a soft brown beetle, which throughout the winter is hardening its shell preparatory to coming out in late spring as a winged creature to feed upon the leaves of trees. The beetle which is walking toward you lives upon the oak.

THE DRAGON FLY (PAGE 593)

No dragon of legend could be more bloodthirsty or terrible than this. With four wings like the supporting planes of an aërodrome, it can fly as fast as a railway train. With thousands of eyes crowded together like cells in a honeycomb, forming eye masses that cover most of its head, it can see in all directions at once. With massive jaws and teeth as sharp as needle points, it can pierce and crush the strongest shell of its prey. With its long-jointed spiny legs held out in front like a basket, it rushes through the air, catches and devours its prey and lets the carcass fall to the ground, all without slackening its terrible speed.

It is hard to realize, as you watch this swiftly moving dragon of the air, that it has spent the first stage of its life as a slowly crawling ugly water monster, lying in wait among the reeds and grasses for some unsuspecting water fly or larva to pass by.

The female, as she skims the surface of some pool, drops into the water her clumps of dragon eggs, a thousand at a time, and from these are born the ugly water-dragons which, when come of age, grow wings and, crawling to the surface, split their old skins open, unfold and dry their closely packed wings, and dart away into the sunshine to prey upon the other creatures of the air.

ONE OF THE BEE-FLIES (*Sparnopolius brevirostris*), PAGE 594

No butterfly or any other creature of the air could be more beautiful than this dream of early summer. Its black velvet body, into which the sunlight sank and disappeared; its fringe of golden hairs along the sides; its steel gray, myriad-facet eyes, of which its head was made, and its delicately formed wings, so thin that the light in passing through them was refracted into rainbow tints, made it seem to me more beautiful than almost any of those gorgeous forms of insect life which sometimes fill the clearings in Brazilian forests.

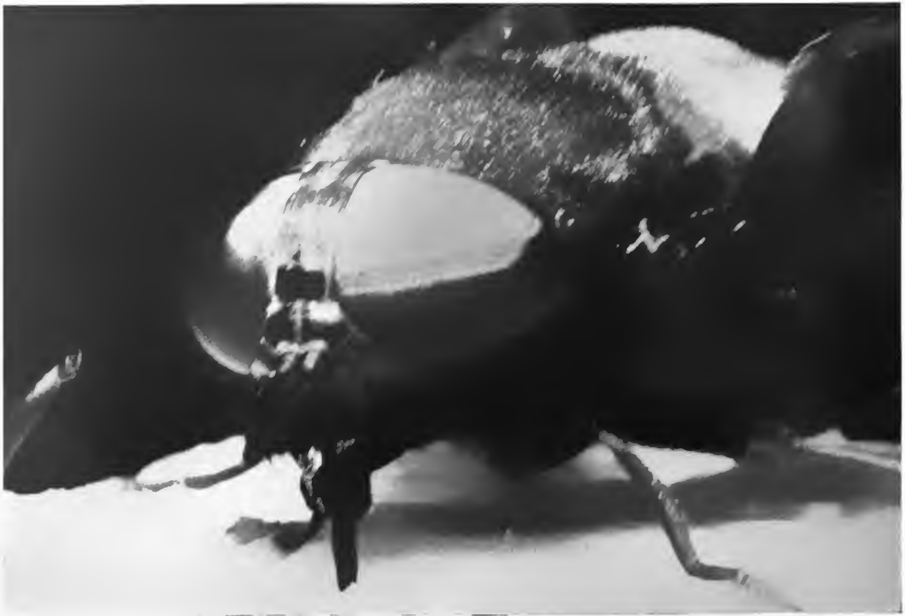
It does seem strange that such a thing as this should live its other life a parasitic grub, within the larva of some caterpillar or in the egg-case of some grasshopper; but so it seems to do. It spends its childhood as a disease and its mating days as a dainty fly among the nectar-bearing flowers.

ONE OF THE ANOPHELES MOSQUITOS (*Anopheles punctipennis*), PAGE 596

The malarial mosquito, so called, has spotted wings, but otherwise it looks quite like this harmless form from Maryland. This whole tribe of Anopheles differs from the Culex in the length of its mouth feelers, which project from the base of the proboscis and appear in the photograph almost as long as the proboscis itself, whereas in a photograph of the Culex it would appear so short as to seem merely a thickening of the base of the proboscis.

The wildest fancy of the Arabian story-teller is lacking in imagination compared with the story which the facts of modern science have woven about these tiny representatives of the fly family.

Who could imagine that just because the lady mosquitos, tiring of their usual meal of ripe bananas and plant juices, acquired the habit of sucking blood, vast regions should be devastated and beings



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THE HORSE-FLY

The thirst for the blood of warm-blooded animals is what makes the horse-fly such a nuisance, and its remarkable eyes, that can see in almost every direction at once, combined with its powerful flight, are what make it so hard to hit (see page 599) millions of times their size should die by thousands. And this, too, not through any real fault of the tiny creatures themselves, but just because some of the persons whose blood they sucked had microscopic wiggling things living in their blood corpuscles, which crawled into the soft throat glands of the mosquito and waited there for a chance to get out into the blood channels of some other human beings.

When one pictures the grief of desolated homes, death-bed agonies, of tossing fever patients, the quarantined vessels at anchor in tropical harbors, yellow flagged, with crews dead or dying, the streets of deserted houses, from which all life has gone forever through yellow fever and malaria, there is something ghastly in the picture of the winged lady mosquitos flitting airily from pale-faced patients to ruddy-cheeked happy people, unwilling carriers of death.

THE HORSE-FLY (*Tabanus atratus*), PAGE 598

The head of the horse-fly appears to be all eyes, and it is no wonder that we can so seldom take them by surprise.

Below the oblong compound eyes are the sharp mouth parts, which in the female are provided with lancets, which enable her to puncture the skin of warm-blooded animals and suck their blood. It is curious that the female should have such habits, while the males are content to lap up nectar from the flowers.

This jet black, loud-buzzing creature flew into my laboratory and made so much noise that I was forced to kill her. This photograph of her is nine times her real diameter.

She belongs to a large and important family of flies, whose females make the lives of men and animals miserable in many parts of the world by their bites, which form most annoying wounds.

THE WORKER BUMBLEBEE (*Bombus vagans*), PAGE 600

This is the real worker of the hive, an undeveloped female, a clumsy rover, her hind legs laden with a mass of pollen from the flowers she has visited.

THE POOR MALE BUMBLEBEE (*Bombus americanorum*), PAGE 601

It was late in October before I noticed, flying low here and there across the clover tops, large bumblebees, which seemed to be more covered with golden hairs than those which I had watched throughout the summer-time. At first I thought them queens, but as their number multiplied I felt I must be mistaken, and one of my insect-knowing friends explained that they were only males, and that with the approaching days of winter they were all doomed to death. Already, he pointed out, their wings were battered and frayed from flying against the autumn winds.

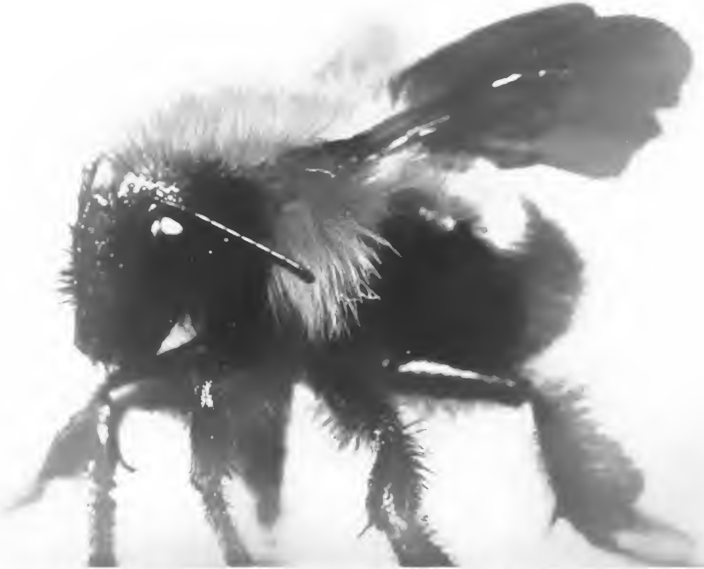
The importance of the males! Could there be a weaker argument against woman's suffrage than that of a noted statesman of the times, in which he said that throughout nature the duty and the right of protection rests with the male? Perhaps the drones do fight among themselves; but, as in most other fighting of the males, it is not to protect the nest or young from perishing, but merely to determine which one of them shall win the queen's attention. They are stingless.

In this world of the clover field all the work of the society is done by the queen herself or by the workers, which are infertile females, and apparently few males are wanted in the colony until late in the season, when for a brief period they are tolerated in considerable numbers as the necessary courtiers who accompany the young queens of late summer in their marriage flight. This takes place before the winter comes to kill all but a few fortunate queens, which find safe shelter in some crevice in the rocks or underneath some old decaying log.

THE PORTRAIT OF THE BALD-FACED HORNET (*Vespula maculata, Linn.*), PAGE 602

I wish I could convey to you my sensation when, in hunting for the focus on my ground glass, this creature burst upon my sight. It was as though, exploring in some strange land, I suddenly stood face to face with a beast about which no school book had ever taught me anything.

It peered at me out of the gloom of



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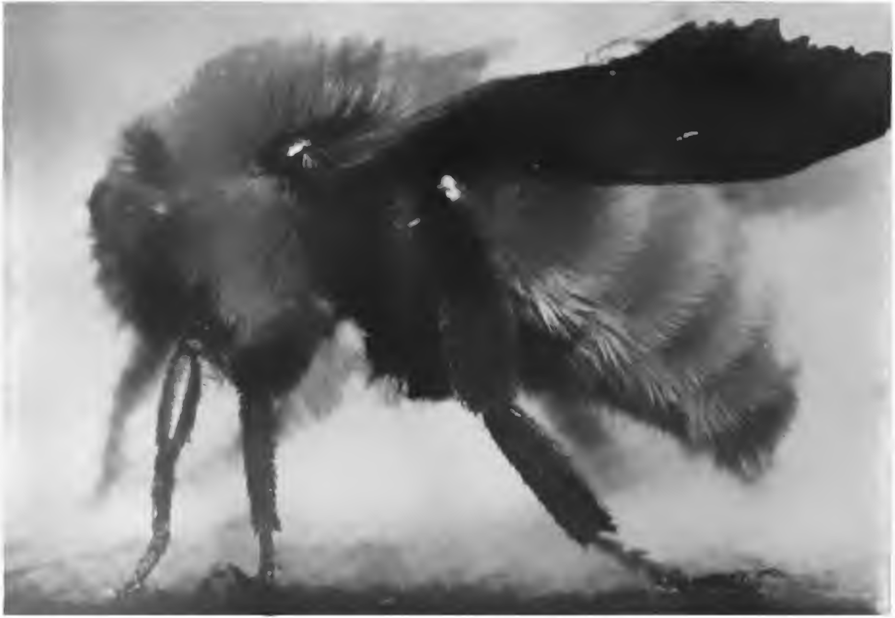
THE WORKER BUMBLEBEE

Everybody has a friendly feeling for the bumblebee, and this portrait seems in keeping with that spirit. The workers are the undeveloped females, and, with the devotion of conscientious trained nurses, they buzz about from flower to flower gathering pollen in their pollen baskets, that are on their hind legs, for the young which hatch from their queen sister's eggs (see page 599)



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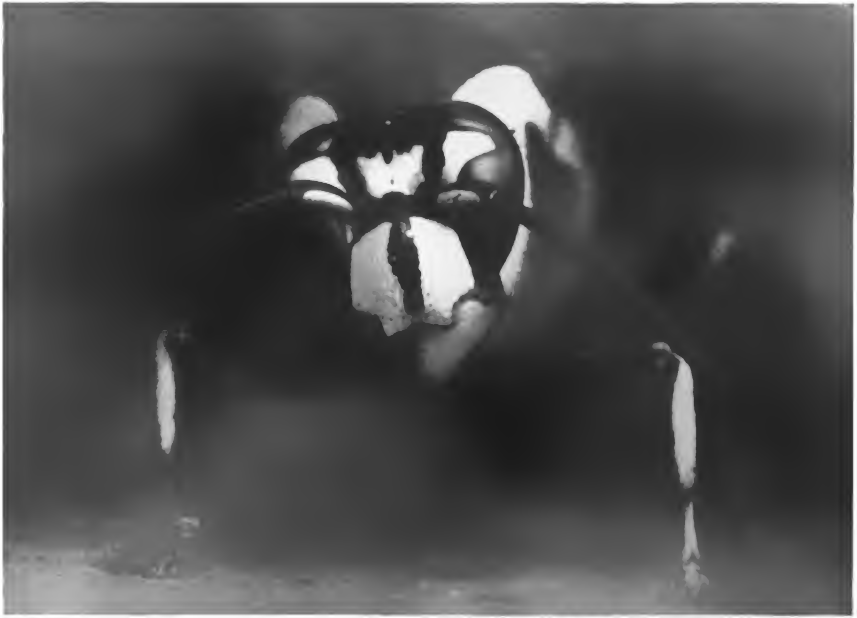
THE POOR MALE BUMBLEBEE

This is one of the courtiers of the hive. Its larger size and hairier body distinguish it from the workers. It leads a very brief existence; just long enough to court some young queen and die when winter approaches. It has no sting, and altogether leads a luxurious life, supported in this luxury by the hard-working, childless females of the colony (see page 599)



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PORTRAIT OF THE BALD-FACED HORNET

If you have ever molested the paper-like nest of this creature and been near enough to look her in the face, you have been braver than most men, for to be stung by her is a more painful experience than any one cares to have. What a terror she must be to the buzzing house-fly! (see page 599) imperfect focus, and it took me some time to realize that I was looking into the eyes of a bald-faced hornet, and that, instead of being an enemy, she is of all the fly-destroyers which frequent the house perhaps the most efficient, pouncing upon the flies with murderous voracity, tearing off their heads and legs and wings and macerating their bodies to a pulp to feed the hungry grub-like baby hornets which are hatching out in the paper nest over the front door.

Does this picture represent, I wonder, one of the nightmare visions which haunt the dreams of baby flies?

There is no wild creature in the northern United States that a man will run away from so fast as from a bald-faced hornet.

At the tip of her flexible armor-plated abdomen is the poison-fed stiletto with which she paralyzes her prey or drives off enemies from the nest.

Her six powerful legs are spined to help her, no doubt, in climbing over the smooth surfaces of flowers and twigs. She has two kinds of eyes—three lens-shaped ones on top of her head and two marvelous compound ones composed of hundreds of little lenses, which take up half the head. Just what she uses each kind for is still unknown.

From her forehead hang ringed antennæ, which doubtless are the organs with which she scents the presence of her prey, and they may also help her find her way about.

Her massive jaws lie below her eyes and look like shears with jagged edges; they are meant for crushing, not for grinding, and with these she tears to pieces bits of wood and cements the particles together with the sticky secretion of her salivary glands, making thus the combs and shelter of her wood-pulp paper nest.

She is an undeveloped female, but with the professional care of a baby's nurse she tends her sister hornets in the nest. On the wing, from daylight to dark, she scours the country for the flies and other insects with which to feed the young.

Her life is ended by the autumn, for she feels the cold as all our insects do, and it is left to a few of the young queens to carry on the species.

There is something fascinating in the picture of the young queen hornet, after mating is over and all her relatives are dead, crawling away beneath some log to pass there the long cold winter, and then alone, when spring has come, emerging from her sleep, the only survivor of her race, to build, unaided even by her mate, the beginning of a nest just large enough to hold her first-laid eggs. From these hatch out the grubs, which later, after days of feeding, emerge as workers, undeveloped females, and help build up around her a colony of hundreds of busy hornets.

THE YELLOW JACKET (*Vespa carolina*), PAGE 604

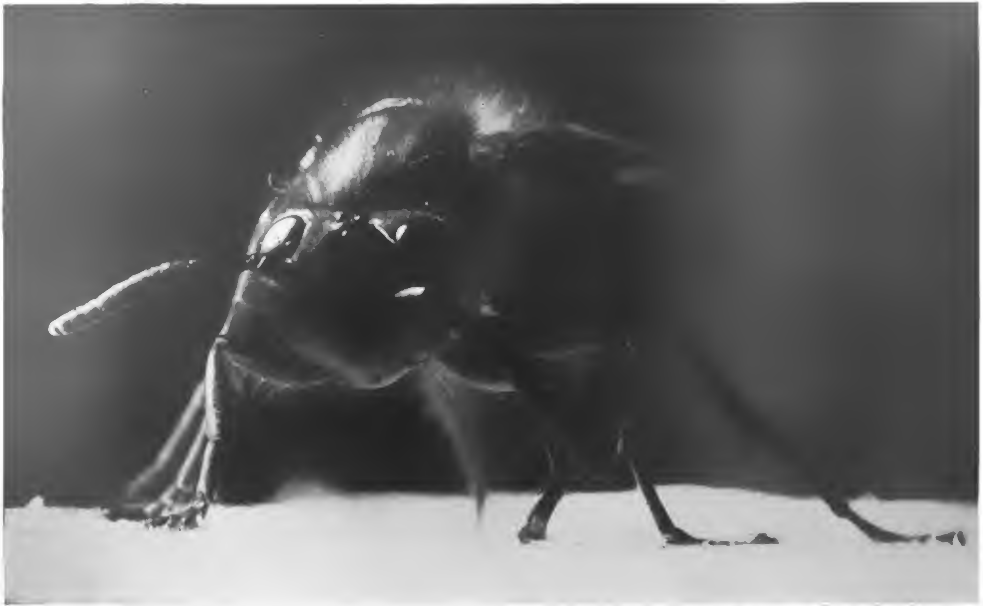
All the readers of the NATIONAL GEOGRAPHIC MAGAZINE have probably had a more intimate acquaintance with the creature shown on page 604 than I can possibly give by any picture. It is the ordinary yellow jacket of our fields.

THE SOLITARY LEAF-CUTTING BEE (*Megachile brevis*), PAGES 606 AND 607

The sting or "stinger" of a bee is indeed a most wonderful piece of mechanism. At the base, inside the body of the bee, lie bars or levers, operated by muscles, which push the darts out and draw them in. The poison sac lies just behind this mechanism and pours the poison into a set of cup-like valves, from which it escapes into the wound along longitudinal groves in the sting like grease along the piston of an engine.

The sting itself is not, then, hollow, like the spider's poison fang.

Unlike the social honey-bees, this bee leads a solitary life. With her strong, saw-like jaws the female makes her burrow in soft wood and lines it with bits of leaf which she has cut in circles from the roses and other plants; then, making a ball from the pollen and nectar which she has gathered, she puts it at the bottom of the burrow, lays an egg upon it, and with a wad of leaves securely shuts it in; over this again lays down another food ball, with its corresponding egg, and so on until the burrow is full.



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THE YELLOW JACKET

Who has not wished that these striped brown and yellow creatures would build their nests where people could see them and be warned to stay away? They hunt in flocks, and is it any wonder that with the sides of their heads all eyes and with three other eyes in the top of the head they should quickly find any one who treads upon their underground nest? (see page 603)

A COMMON RED ANT (*Formica sp.*), PAGE 608

There are probably five times as many species of ants in the world as there are species of birds in the whole of North America. There must be hundreds of times as many individuals. "They are undoubtedly the highest, structurally and mechanically, of all insects and at the same time the most efficient." Their social organization has been the admiration of human beings from the earliest times, because the interest of the individual is merged so completely into that of the colony; but, as Wheeler remarks, their organization must strike the individualist with horror. It is an organization of females, too. The workers are females, the soldiers are females, the nurses are females, and there is one queen mother for them all, who lays all the eggs of the colony. Where are the males, those representatives of society, those voters of our human colonies? They do not exist as such, for the males of ant colonies are but mates for the young queens. Together with them they leave the nest on their marriage day and together make the marriage flight, but as soon as this is over they die and the colony gets on easily without them. To man, who is the most rapidly evolving organism on the earth today, it is a strange thought that the most highly developed insect which the world has produced, and which has not changed materially since the Tertiary epoch, has relegated the males to the short-lived function of reproduction, leaving him no work to perform and getting rid of him as quickly as possible. Why did the ants, with their marvelous instincts, fail to conquer the world? Why have they stood still for thousands of years after they had perfected their social organization? Did they go as far as evolution could go when it leaves the male out of account? It is perhaps a comfort to think that, after all, they have failed and the manguided organization of human beings has surpassed them in its development.

FORE PART OF A BROWN BUTTERFLY (*Argynnis cybele*), PAGE 610

It is hard to realize that this is the portrait of the head and fore part of a beautiful brown butterfly.

Its head is almost all taken up with the gigantic eyes, which are composed of thousands of tiny facets. The long, trunk-like mouth with which it sucks the nectar from the flowers is coiled up like a watch spring. Like shingles on a roof, the scales are fastened in tiers over the broad surface of the wings stretched over the stiff ribs or frame-work.

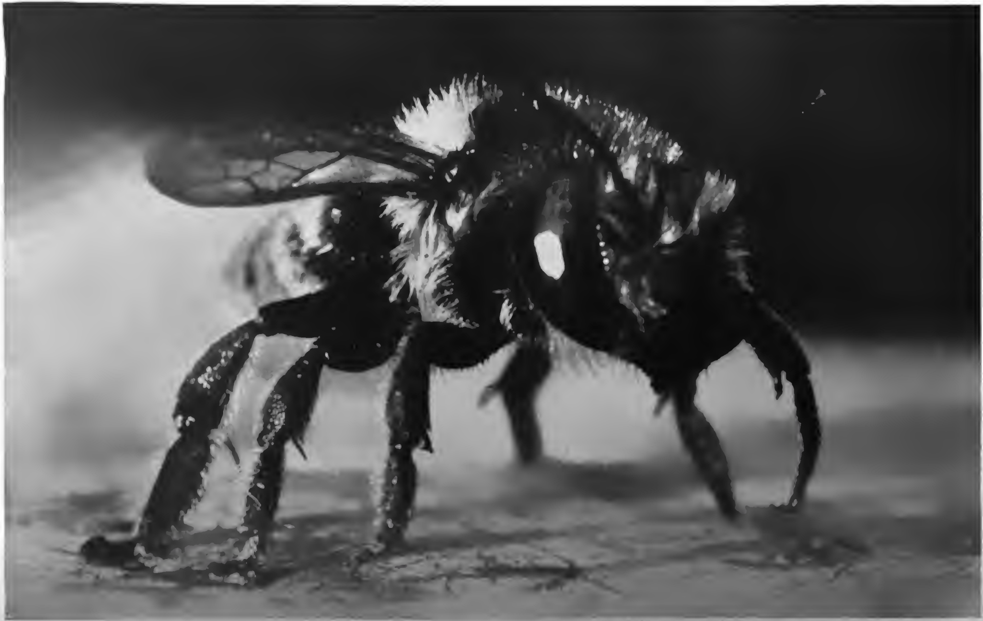
The white spots are made by hundreds of white scales and the brown blotches by brown scales, and what these scales are for nobody seems to know. Perhaps they help to grip the wind, for they have running lengthwise of them deep and parallel corrugations so small and fine that were a single scale as large as a lady's opened fan these corrugations would represent its sticks.

The caterpillar from which this splendid creature came is black, with branching spines and feeds at night on violets and other plants.

The graceful beauty of the butterfly, its seemingly happy existence, its life among the flowers, where it sips the nectar that the flowers provide, are all a part of common knowledge.

The real life of the butterfly, however, is not so pleasant as we think. Have you ever found a butterfly hanging beneath a leaf on a cold summer morning drenched with dew and stiff with cold? Have you ever seen one trying to cross a field in a rain-storm and observed it vainly attempting to navigate the conflicting air currents? Where do they roost at night and on rainy days? Where do they come from and what becomes of them? These are matters which it has often taken men years to find out, and even now there are many thousands of species of butterflies which are known only by a preserved specimen caught in its flight by the net of some collector.

It is easy to tell any butterfly from a moth by the clubs which it has on its antennæ, and although the entomologists have decided that this classification is unscientific, it is quite as uneducated to call one of these beautiful creatures with club-shaped antennæ a moth as it is to call a mouse a rat or a lizard a snake.



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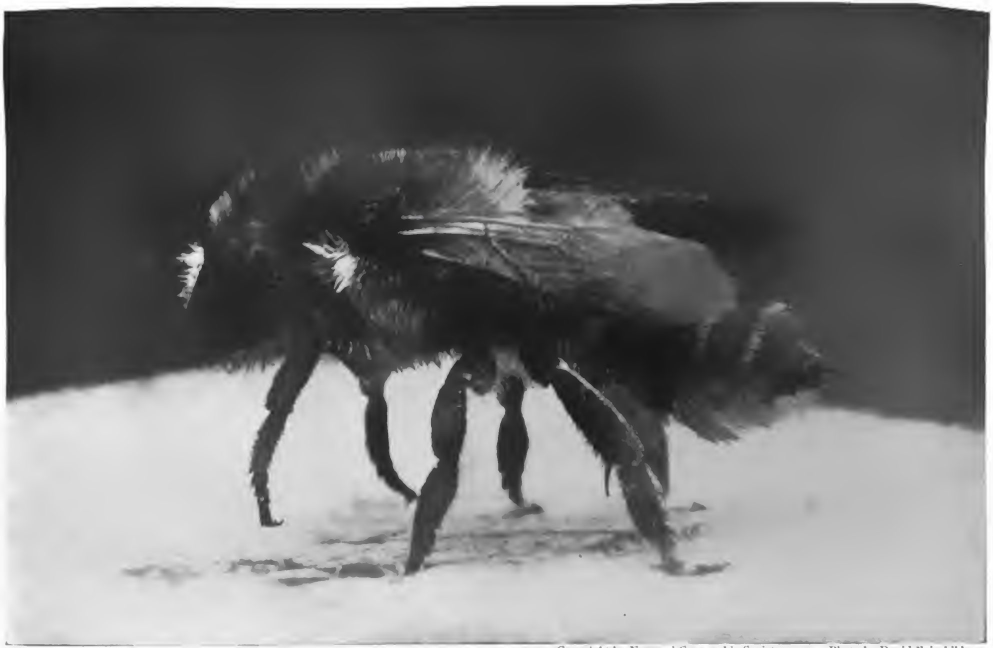
A SOLITARY LEAF-CUTTING BEE (FRONT VIEW)

When the rose leaves in the garden have round holes through them, in nine cases out of ten they have been cut by this solitary bee. She uses the round pieces to line her burrow with, gumming them together with the sticky secretion of her mouth. Her young never see her, for they hatch out after she is gone and feed on the balls of pollen and nectar she has gathered for them (see page 603)



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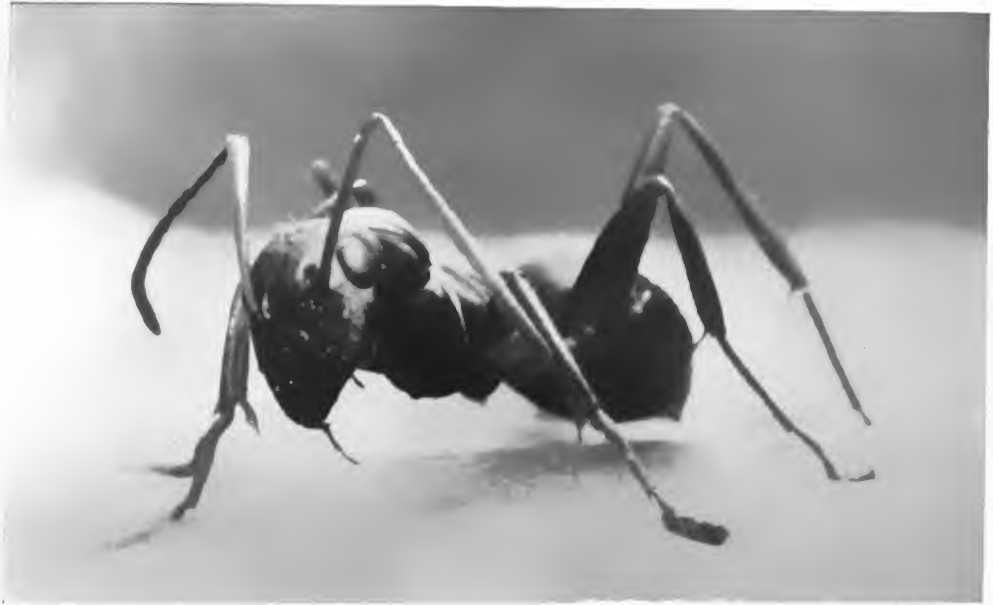
A SOLITARY LEAF-CUTTING BEE (SIDE VIEW)

Are there any other flying creatures which have such a weapon of defense as this one has? A poisoned stiletto as long as her forearm, which she can thrust in and out with incredible rapidity, and which, as every one knows, can inflict a painful wound on creatures millions of times her size (see page 603).



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A COMMON RED ANT

This individual belongs to one of the oldest and most remarkable social organizations of female creatures in the world. Its ancestors, embedded in amber thousands of centuries ago, were almost identical in structure, and its instincts seem as rigid and unchangeable as its structure. The interest of each member is so completely merged in the welfare of the colony as to strike the individualist with horror (see page 605).

Of the butterflies, so called, which flit across our lawns and flutter from the grass as we brush through it, nine out of ten are moths with feathery or pointed antennæ.

It is said of certain species of yellow butterflies that the males give off a pleasing, aromatic odor which is exhaled from the front wings through hundreds of minute, slender scales—scales quite different from those with which the wings and body are covered. This scent, which is so strong that it can be detected by even our blunted olfactory organs if we rub the wings between thumb and forefinger, is supposed to attract the females in some way that is little understood. As among these particular butterflies the male seeks out its mate, it is difficult to understand why it should be the male which has the perfume, since it does not serve to tell the female where her mate is to be found. The inference is that in some way the perfume charms the female.

In some species it is the females which give off an odor and in either case the distances over which these odors extend and are detected by the males or females respectively are analogous to the inconceivable reach of wireless telegraphy. And who knows but the mechanism of these creatures is set to respond to the swifty traveling ions which make wireless telegraphy possible.

The Doctor Jaeckel and Mr. Hyde is so complete between the butterfly which flits over the cabbage patch and the velvety green worm that eats holes in the leaves of the cabbages that it is no wonder that for centuries no connection between the two careers of these creatures, seemingly so far apart, was suspected. In general it is true that no moth or butterfly is injurious to plants except in its larval stage, and herein has laid the clever deception which has doubtless protected these gay mating creatures of the air from the systematic attacks of man until quite recent times.

LARVA OF THE SWALLOW-TAIL BUTTERFLY OF THE SPICE-BUSH (*Papilio troilus*), PAGE 611

Is this, I wonder, an insect make-belive, a caterpillar mask, as it were, to frighten away enemies? The black and white eye spots are not real eyes, but to a bird they doubtless seem so. Its real eyes are inconspicuous points at each side of the head, too small to appear in the photograph.

Few of us stop to think as the beautiful swallow-tailed butterfly, gorgeous in its black and yellow painted wings, flits by us that it is made of sassafras and spice-bush leaves gathered together and ground up. This monster is a leaf-eating creature, its purpose being the accumulation of food material out of which is made inside of it the gorgeous swallow-tail butterfly. It feeds on sassafras and spice-bush leaves, and when the time arrives makes a nest for itself by fastening the edges of a leaf together. In this nest it passes the winter. When spring comes it breaks open the gray shell of the chrysalis, unfolds a pair of black and gold wings with long tails to them, and flies away in the sunshine in search of flowers and a mate. It is then no more like this monster than an eagle is like a hippopotamus, yet after it has flown about, sucking nectar through its long beak, it mates and lays a mass of eggs, out of which hatch again these strange, weird beings.

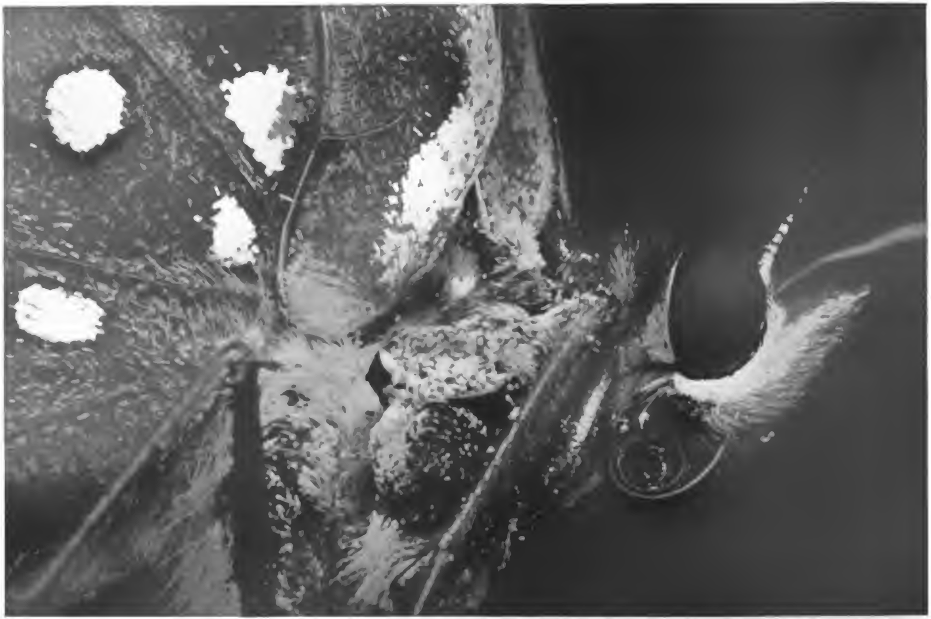
A BUG THAT IS ALWAYS WALKING AROUND (*Brochymena arborea, Say*), PAGE 612

This is, as my friend Dr. Schwartz says, just one of those bugs that is always walking around on plants, and nobody seems to know just what it is doing.

A QUEER UNWORLDLY MONSTER (*Corynocoris distinctud*), PAGE 613

Could anything be more antediluvian and unworldly than this old broken-down creature, with six crooked legs, a pair of popping-out eyes, two shining ocelli which look straight up into the air, and a long stout beak that is partly hidden behind one of the fore legs?

A discussion of how such a fright of a thing came into existence leads one into the realms of evolutionary science, and there we should perhaps find it suggested that it is so ugly and looks so much like the bark of the trees on which it roosts that birds have passed its ancient forefather by, and through the



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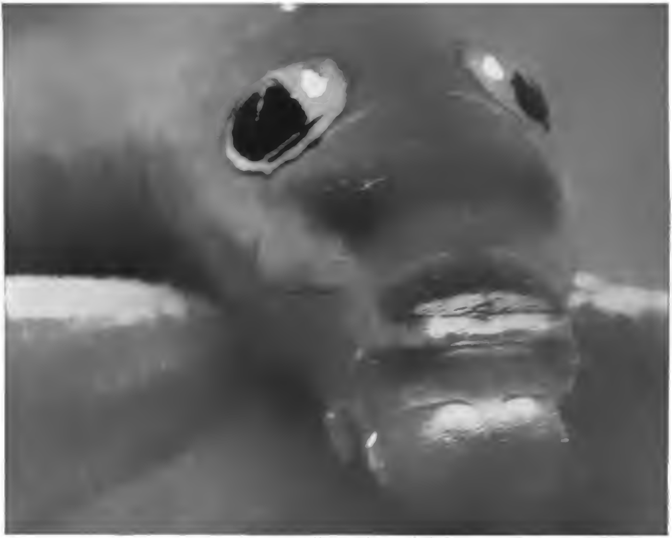
FOREPART OF A BROWN BUTTERFLY

Nature seems to make her short-lived children just as beautiful, perhaps even more so, than the long-lived ones. These gorgeously colored wings which attract our attention by their great patches of white and red and are made beautiful by millions of scales, each of which is in itself a thing of exquisite beauty, are made for the service of a few sunny days only (see page 605).



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LARVA OF A SWALLOW-TAIL BUTTERFLY

It would be interesting to discover whether to a bird or other enemy the black and white eye-spots, which make of this caterpillar a fit subject for a nightmare, appear as monster eyes and frighten it away. The true eyes are small, invisible ones at either side of its light-gray head (see page 609).

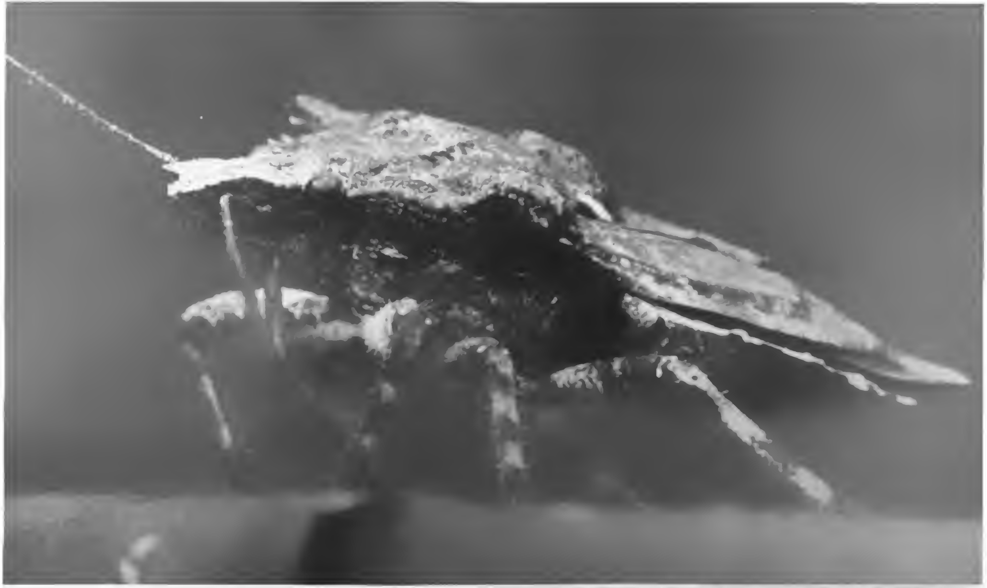
weird workings of that little-understood law of heredity this thorny, spotted creature has waddled along year after year, keeping up in the race for hundreds, perhaps thousands, of centuries. I cannot help exhibiting a little of the showman's pride in it; for, as Barnum would say, this is positively the first real appearance of this century-hidden, hoary monster before the every-day public.

According to the books, this species belongs to a strange family, in which are even more remarkable-looking creatures. They are all, however, characterized by having the femora of their back legs covered with knobs or spines. One of the species is so spiny all over its back that the male makes use of it to carry around the freshly laid eggs of the female.

THE SQUASH-BUG (*Anasa tristis*), PAGE 614

The smell of the squash-bug is known to every country boy. The odor is emitted through openings in the abdomen from special stink glands, which vary with each species.

The tough external skeleton explains perhaps why no spray is strong enough to kill the fully grown insects without also injuring the young squash and pumpkin vines, and why the best method of prevention consists in screening the young plants with a wire screen until they have grown large enough to be immune from attack. If you can find the young insects which are not yet encased in such a hardened shell, spraying with a 10 per cent kerosene emulsion will stop



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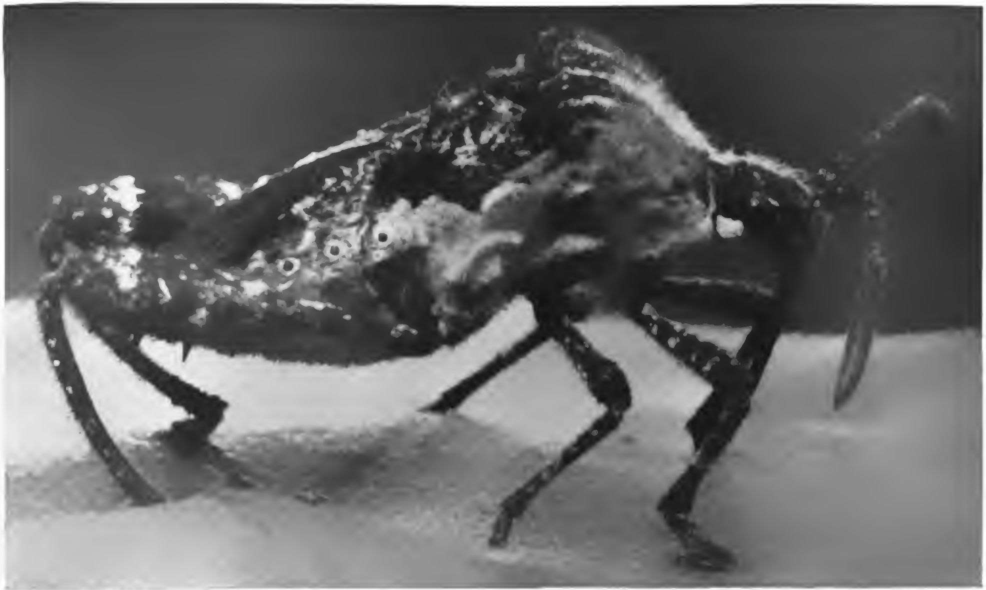
A BUG THAT IS ALWAYS WALKING AROUND

The fields are so full of strange-looking creatures that the habits of this one, which looks like a six-legged oyster, are not well known even to entomologists (see page 609)



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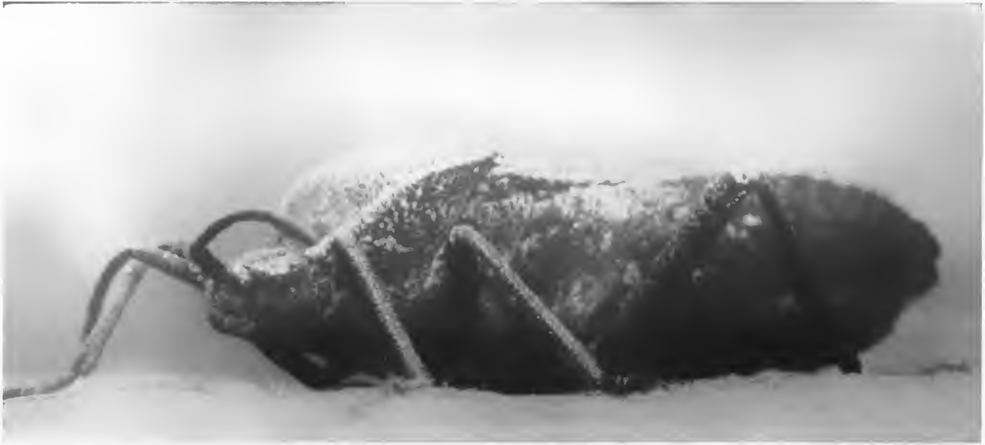
A QUEER, UNWORLDLY MONSTER

Merely one of the thousands of weird creatures which inhabit the jungle of our back yards, and which, were they as large as this photograph, would be as familiar to us as are the squirrels and rabbits which we find there; but which, because they are only a half inch long, are known by name to a few men only (see page 609).



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THE SQUASH-BUG

It would be hard to get at the true character of the squash-bug, but looked at from the side and on his own level, he appears to be a rather clumsy creature, with a prodigiously thick hide, an eye which pops out of his head, two jointed antennæ, and a beak which is tucked under his chin. If he were as large as the photograph, he would be an ugly customer in the garden; in fact, he is that anyway, though he is not an inch in length (see page 611).

up their breathing pores and asphyxiate them.

The one in the picture is an old specimen, preparing to go into winter quarters under the leaves and wait for the tender squash and pumpkin vines to appear above the ground.

It is surprising how quickly they find these juicy shoots, which they pierce with their sucking beaks and upon which they lay the eggs which in a few days hatch out into a brood of small but voracious squash-bugs.

It is difficult to realize that the species to which this creature belongs is only one of 5,000 distinct species known in North America, or to fully comprehend the force of a remark made by David Sharp, the English naturalist, that "if anything were to exterminate the enemies of the true bugs, we ourselves should probably be starved in the course of a few months."

In other words, it represents an order of sucking insects of many strange shapes which, although directly connected with the welfare of the human race, has been, until recently, the most neglected of all the great orders of insects.

To this order belong the chinch-bugs, the cause of an estimated loss to grain-growers of 20 million dollars a year; the great Phylloxera, which destroyed the vines on 3 million acres of French vineyards, and the San José scale, which has spread during the past ten years through every State and Territory in the United States and become a menace to the fruit-growing industry.

AN ORB-WEAVING SPIDER (PAGE 616)

This creature has eight four-jointed legs of varying lengths, covered with large bristles which are hollow and sensitive. Hidden behind these legs is the head, with eight eyes, strong jaws, poison fangs, and a pair of palpi which look like extremely short legs and seem to serve as hands. The hairy body is filled with thousands of eggs and contains also a marvelous reservoir of liquid rope opening into spinnerets on the under side of the body.

Before you are up on a summer's morning, this wonderful creature will have manufactured what would be equivalent to two miles of elastic and sticky rope if she were as large as a six-foot man. With the skill of an experienced fish-net maker, she will in a few hours construct a net as large as a cart-wheel, with tough, dry, radiating spokes, between which are looped sticky, elastic threads, which no little flying creature can strike against without running the risk of sticking fast.

A VAGABOND SPIDER (*Pardosa milvina*), PAGE 617

This is a vagabond of the spider world, building no nest or web, content to use her marvelous silk in the construction only of a sac in which to lay her eggs. This sac she carries about with her until the eggs have hatched and the spiderlings are strong enough to take care of themselves, and then she rips open the sac along a distinct seam on the edge and turns her babies loose to shift for themselves.

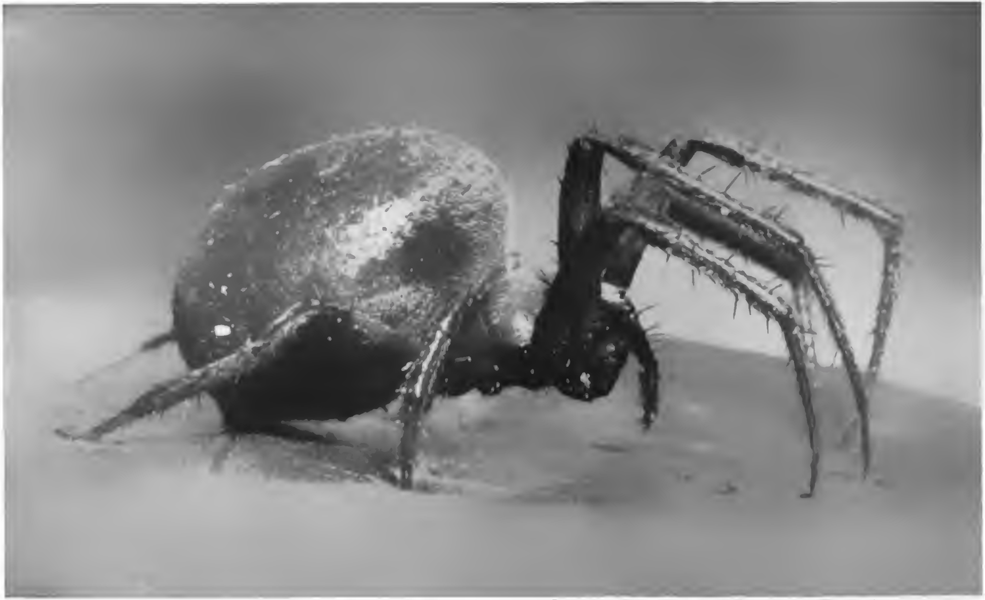
These voracious little cannibals have, however, already learned to forage, as the struggle for existence in many species of spiders begins in the egg sac, and it is only the strongest who emerge. In other words, they eat each other up.

They do not grow to be more than half an inch in length, but they are among the most active of all spiders, and in the United States alone there are nearly a score of species of these little soldiers of fortune living nowhere and roaming the damp fields in search of prey.

A JUMPING SPIDER (*Phidippus audax*), PAGE 618

We are so accustomed to beasts with two eyes that it is hard to realize that all around us, though hard to see, are little monsters with many eyes of various sizes.

This one has eight eyes, four of which are invisible from the front. The eyes are diurnal, enabling the creature to hunt only by day. Its eight stout legs fit it for jumping forward or sideways with great ease. In comparison with its size, its jumping powers are incredible. If it were the size of a tiger, it would be a



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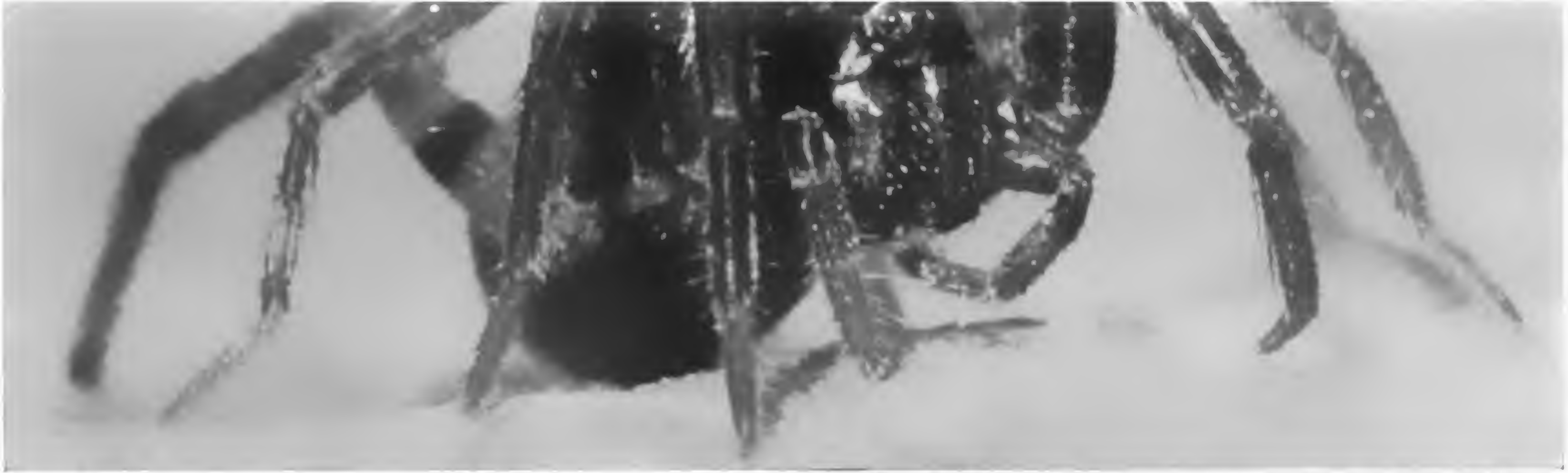
AN ORB-WEAVING SPIDER

It is only when one rises early and wanders through the fields and sees the dew-covered webs of the orb-weavers that he realizes how all about are wonderful creatures, with long, muscular legs and hairy bodies, which hang all their lives through to nets made of a secretion of their own bodies, waiting for their food come to them (see page 615).



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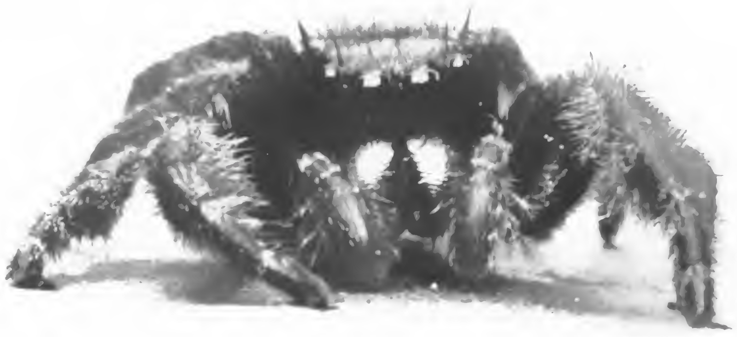
A VAGABOND SPIDER

It would be hard to imagine a creature more fitted to live off the game it catches than this wandering spider hunter. To see it pounce upon its prey and kill it with one stroke of the fangs through its head is to get some idea that the struggle for existence is not merely a phrase to be found in the works of the great Darwin (see page 615).



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A JUMPING SPIDER

This spider builds no web, but sitting in ambush, on some leaf or twig, it waits until some flying creature passes near, when it springs and catches it in midair, spinning out behind it a drag-line, back along which it climbs with its prey in its jaws. What must the sensations of a fly be when he looks into the diabolical countenance of this monster, no matter if he is only a quarter of an inch long! (see page 615).

beast of prey which could clear a quarter of a mile at a bound.

It can sit on a branch and throw out an elastic dragline behind strong enough to bear its weight, and by this means it is able to jump at and catch its prey on the fly, regaining its position by climbing up the dragline. Add to this that it possesses a pair of powerful hollow fangs, into which poison sacs empty, and a voraciousness which often leads it into cannibalism, and you have a fair picture of this jumping spider, which is one of a thousand species of little creatures found everywhere except in the polar regions. They range in size from a third to a half an inch long and live under stones and sticks, spending the winter in a silken bag of their own manufacture, but never spinning a web. The males of some species have been observed to dance before the females, holding up their hairy legs above their heads to show off their ornamentation.

THE WOLF-SPIDER (*Lycosa carolinensis*), PAGE 620

This is not the photograph of a polar bear, but that of the wolf-spider, with a battery of eight eyes on the top of its head and poison fangs hanging below.

Behind and above the fangs and hidden in their shadow is the creature's mouth—toothless and made for sucking only. With his fangs this wolf-spider kills and crushes his victim; then he sucks the body dry and throws away the carcass.

Seen here and there above the body hair are black spines, hollow inside and connected with the nerves of touch. Of his eyes, the two in the center in front are supposed to be for use by day, while all the others are nocturnal, enabling him to stalk his prey at dusk. It is the wolf-spider that often appears at night within the circle of lamplight searching for nocturnal insects.

The nocturnal eyes are remarkable organs, with reflecting structures so placed behind the retina that the light entering the eye traverses the retina twice, and it is supposed that this reflecting structure increases the effect of any faint light, enabling the creature to "see in the dark."

This is a hunting spider, chasing its prey through the grass or lurking under stones, especially in damp places.

It does not spin a web, but lives in a silk-lined hole 6 or 8 inches deep, which it digs in the ground, and around the entrance to which, out of sticks and grass, it builds a turret or watch-tower, from which it can see its prey more readily than from the ground. These spider holes are common in the meadows of Maryland.

In form and color the wolf-spider resembles the famous tarantula of southern Europe, the bite of which was supposed to cause the tarantella, or dancing madness; but it is as harmless as a butterfly, and indeed Dr. Comstock, who is the authority on spiders, believes that no spiders in the Northern States are poisonous to man.

SKELETON OF A WOLF-SPIDER (*Lycosa punctulata*), PAGE 622

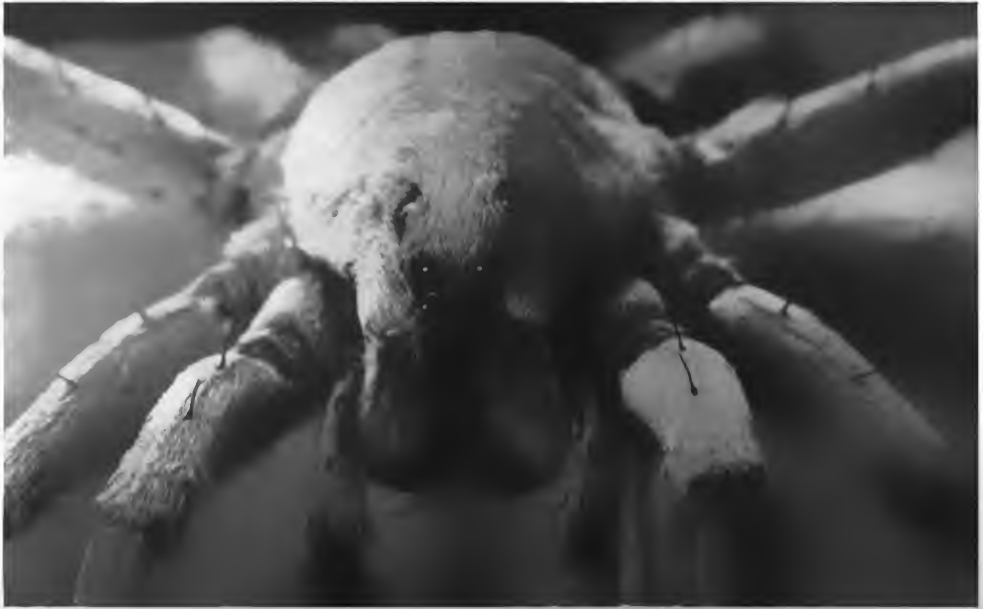
This photograph is the outer skeleton or shell of a small wolf-spider which I found clinging to the focusing cloth of my camera after it had been lying on the grass.

With us the bony skeleton is internal and grows as we grow. With spiders the skeleton is a tough, bony structure, which cannot change; so that the young, rapidly growing spider soon finds his shell too tight for him, and, like a crab, he bursts his shell and pulls his soft body from each leg and complicated cavity.

This process seems marvelous, but is really comparatively simple when we realize that before the old shell is cast off it is loosened from the new skin by the moulting fluid which is excreted from glands opening through this new skin.

After the old skin is loosened it splits along the sides of the body and in front of the eyes, the slit being just above the legs and jaws, and that portion of the old skeleton which had covered the back is lifted off like a lid. The new skin, at first elastic enough to accommodate the increased size of the body, soon becomes hardened like the old, and must in its turn be shed.

Imagine, if you can, the surprise of a wolf-spider who in running through the



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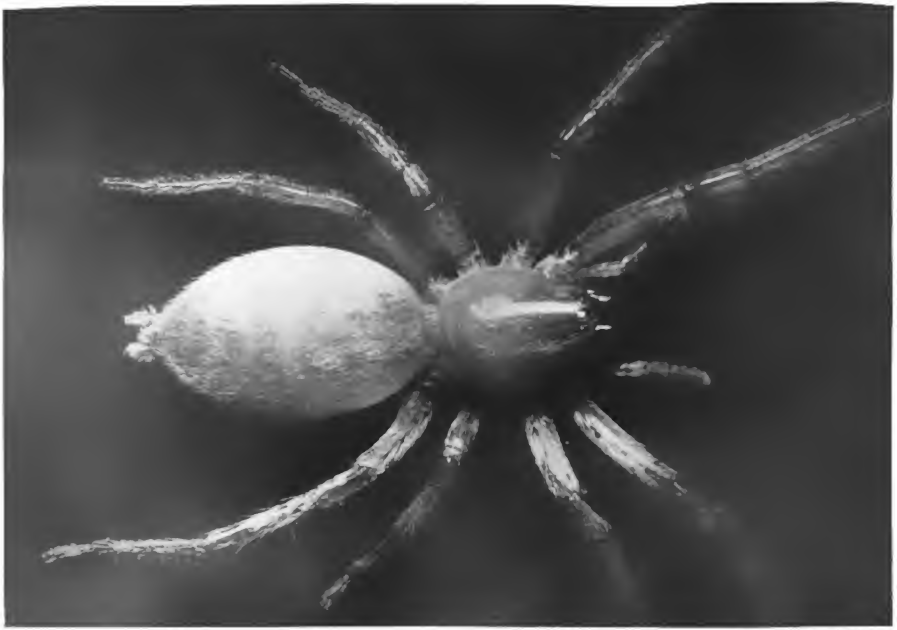
THE WOLF-SPIDER

Some such an impression as this, I imagine, must be made on the retina of a bee or a wasp when, in wandering through the grass, it suddenly finds itself face to face with a wolf-spider sitting on the turret which forms the entrance to its web-lined hole in the ground. This spider spins no orb, but stalks its prey, or waits for its approach at the entrance to its nest (see page 619).



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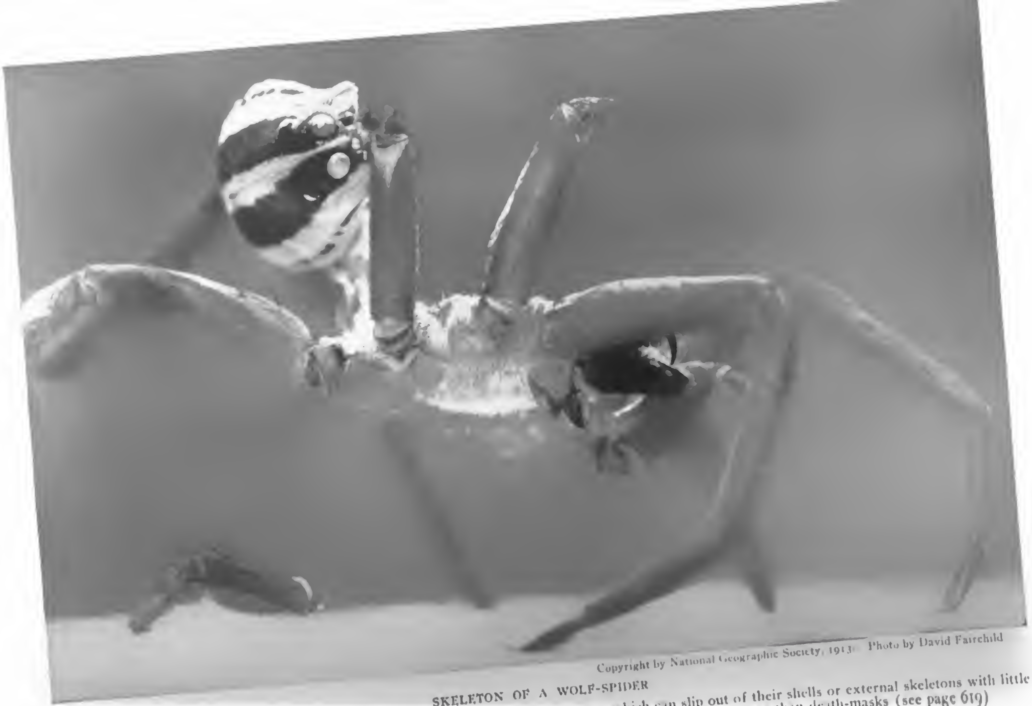
A SMALL WHITE SPIDER

This is the view we ordinarily take of the spider. Its legs and body are what we see, while its face and expression are lost, quite as much as the expression of our faces would be if only the tops of our heads were shown. This spider was taken from a mud dauber's nest and was paralyzed.



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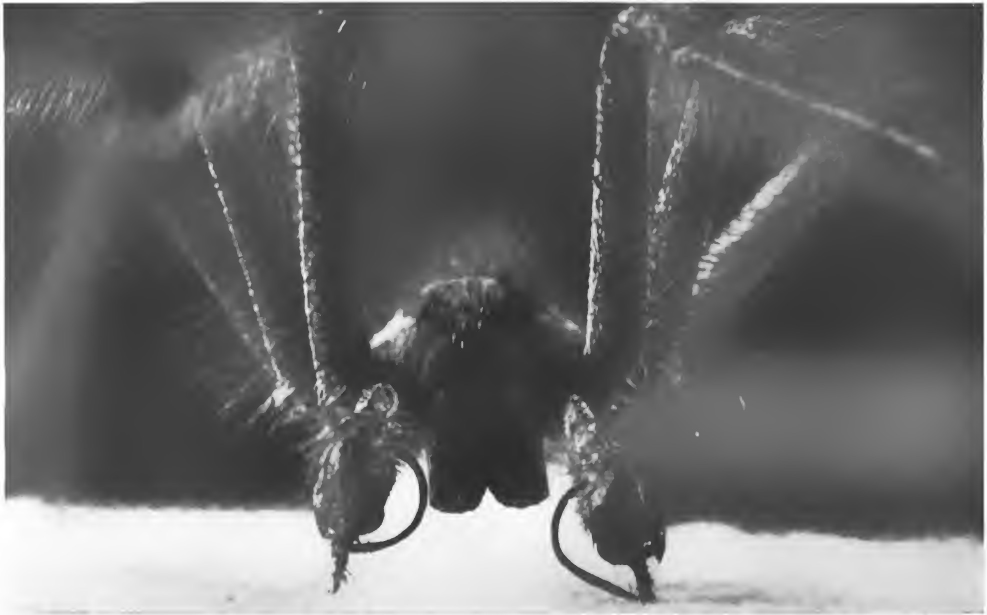
SKELETON OF A WOLF-SPIDER

It is difficult to realize that there are creatures, and many millions of them, too, which can slip out of their shells or external skeletons with little more trouble than we can change our clothes, leaving behind facsimiles of themselves more accurate than death-masks (see page 619)



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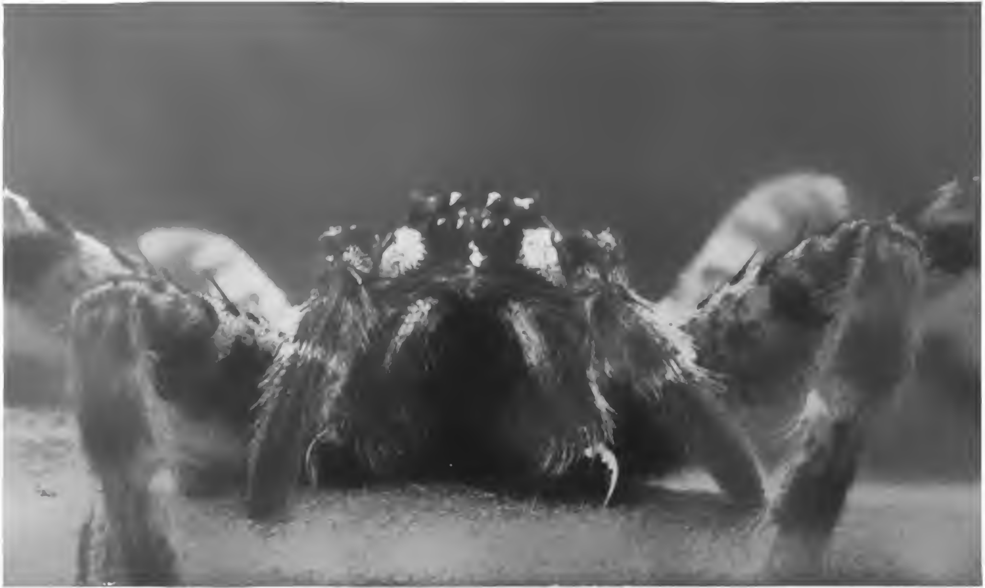
A MALE SPIDER

No discussion of the subject of sex in animals would be complete without consideration being given to the genital palpi of the male spider, strange organs of reproduction developed upon the tips of the pair of short leg-like palpi during the last moult



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A SPIDER FROM A FLY'S POINT OF VIEW

Civilized man rarely sees displayed the real ferocity of wild beasts, for even in the jungle it is hard to observe. To any one, however, who will watch a spider devour a fly, the true picture of merciless cruelty will be apparent. With its poison, sword-like fangs it first kills its prey and then with its sucking mouth-parts it sucks the soft juices out of the carcass (see page 625).

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ALL THE MONSTERS PICTURED ON THE PRECEDING PAGES, AND MANY MORE, IMPRISONED IN ONE MUSEUM CASE

They are all pinned in the box and have dried out and changed almost beyond recognition, but the impression which their portraits have made will, I hope, be lasting

grass should stumble over his own outgrown skeleton, so like his former self in all its details that he could scarcely fail to recognize it as his own; for even the transparent cornea of the eye is a part of this outer skeleton and is shed with it, as well as the jaws, sensitive spines, and hairs.

A MALE SPIDER (PAGE 623)

The long legs and low-swung body of this creature fit it peculiarly for running, and the curious structure of its short front legs, or palpi, show it to be a mature male.

A SPIDER FROM A FLY'S POINT OF VIEW (*Dolomedes tenebrosus, Htz.*), PAGE 624

A spider from the fly's point of view is a terrible monster indeed. Its claws of polished chitin, sharp as sword points, each with an aperture leading to a sac filled with deadly poison; its array of eyes of different sizes, its mottled, hairy skin covered with hollow sensitive bristles, and its powerful leg-like palpi must strike terror to the heart of any fly or cockroach which may happen in its neighborhood.

It is hard for man, who has conquered all the beasts of the forest by his superior intelligence, to realize what a struggle for existence is going on about him in the grass beneath his feet. Imagine being pursued on every hand by enemies like this, and having to be on the alert every instant of your brief existence lest you fall into the clutches of some absolutely merciless monster.

Having conquered the beasts which he can see and shoot, man is turning his attention to these minute monsters and is coming to realize their gigantic importance to the human race. Species of beetles no larger than a bird-shot have destroyed more forests than all the forest fires, and bugs no larger in size have caused an annual loss of 200 millions of dollars to the grain-growers of a single country. The fence corners, the old logs, the stone piles, the stumps, and the weeds everywhere are breeding-places for these strange creatures, and you can no more maintain a vegetable garden or run a successful orchard without making provision to protect your plants from them than a man can raise chickens in an African jungle without a dog-tight fence to protect them from the wild beasts.*

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* Although perhaps not customary in an article of this character, I wish to publish my indebtedness to those who have helped to make its preparation possible; to Dr. N. A. Cobb for blazing the way by his house-fly photographs, published in the National Geographic Magazine, May, 1910; to Dr. L. O. Howard and his colleagues of the National Museum for naming the insects; to Scott Cline for developing all the negatives and making all the prints; to L. C. Crandall for making valuable suggestions; to Mr. and Mrs. Alexander Graham Bell, and Mr. Barbour Lathrop, of Chicago, for their enthusiastic support; to Miss. C. J. Aldis and Mrs. F. A. Keep for revisions of the manuscript, and to the members of the Entomological Society of Washington for their kindly criticisms during its first reading.

Although the personal pronoun has been used throughout the article, I wish to make it clear that Mrs. Fairchild is quite as responsible as I am for the taking of these photographs.

THE MONARCH OF THE CANADIAN ROCKIES

The Robson Peak District of British Columbia and Alberta

By Charles D. Walcott

Secretary of the Smithsonian Institution

ROBSON, the most majestic peak of the Canadian Rockies, is situated northwest of the Yellowhead Pass, through which the Grand Trunk Pacific and the Canadian Northern railways have been building their lines to connect the great interior plains and granary of Canada with the Pacific coast. Known to trappers of the Hudson Bay Company and a few hardy explorers who have penetrated the region in search of a practicable trail to the Pacific, the region remained almost a *terra incognita* to the outside world until Dr. A. P. Coleman described his attempts to scale Robson Peak.

Messrs. Milton and Cheadle, in their search for the "Northwest Passage by Land," * give the first graphic description of Robson Peak as they saw it from the Fraser River.

"On every side the snowy heads of mighty hills crowded round, whilst, immediately behind us, a giant of giants, and immeasurably supreme, rose Robson's Peak. This magnificent mountain is of conical form, glacier-clothed, and rugged. When we first caught sight of it, a shroud of mist partially enveloped the summit, but this presently rolled away, and we saw its upper portion dimmed by a necklace of light feathery

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* "The Northwest Passage by Land," by Viscount Milton and W. B. Cheadle. Page 257. Published by Cassel, Petter and Galpin, London. 1865.

Photo by R. C. W. Lett, by courtesy of Grand Trunk Pacific Railway

OUR FIRST BEAR: THE SKIN AND SKULL ARE NOW IN THE U. S. NATIONAL MUSEUM

clouds, beyond which its pointed apex of ice, glittering in the morning sun, shot up far into the blue heaven above, to a height of probably 10,000 or 15,000 feet."

Thirty-three years later (1898) Mr. James McEvoy, of the Geological Survey of Canada, made a reconnaissance from Edmonton west over the Yellowhead Pass and saw Robson Peak from the south. He fixed its geographic position and assigned it a height of 13,700 feet, stating that it has the distinction of being the highest known peak in the Canadian Rockies. McEvoy also made some geological observations, and on his map of 1901 includes the Robson region north of the Fraser River Valley as Upper Cambrian or Castle Mountain group.

THE FIRST ASCENT OF THE MOUNTAIN

In 1907 and 1908 Dr. A. P. Coleman, of the University of Toronto, began exploration with the purpose of attempting to ascend the peak. He found it impossible (1907) to climb from the south, where precipitous cliffs rose terrace on terrace from the valley of the Grand Forks 9,000 feet to the snow-clad summit.

The following year (1908) Dr. Coleman, guided by an Indian, went up Moose River and over the pass to the Smoky, reaching the foot of Robson

Photo by R. C. W. Lett, by courtesy of Grand Trunk Pacific Railway

PREPARING SKINS OF SMALL GAME ON A RAINY DAY

Peak on the northeastern side. He there made two attempts to climb the mountain, but was driven back by storms and returned after enduring many hardships.

He was accompanied by Rev. George Kinney, who returned the following year (1909), and on August 13, with Donald Phillips, ascended the peak. When they reached the summit, fresh snow began to fall and soon night was gathering. It was only after incurring great risks for seven hours on the storm-swept ice and rocks that they finally descended to a place of safety and told how they had carried their flag to the highest peak in the Canadian Rockies.

Dr. Kinney later wrote that on the summit it was too cold to stop, and on the way down the danger was so great that they could not stop. Twenty hours of strenuous work brought them to their camp in the valley of Berg Lake.

Friends have asked how I happened to take up geologic work in the Canadian Rockies. The reason is a very simple one.

As a boy of 17 I planned to study those older fossiliferous rocks of the North American Continent which the great English geologist Adam Segwick had called the Cambrian system on account of his first finding them in the Cambria district of Wales. This study has led me to many wild and beautiful regions, where Nature has glorified these old sea-beds by thrusting them up into mountain masses, with forests below, and crowning them with perpetual snow and ice.

It was to learn the geology and the record of the life of Cambrian times that led and forced me summer after summer to traverse and live in those grand and beautiful Rockies.

OUR HUNT FOR FOSSILS

In the NATIONAL GEOGRAPHIC MAGAZINE for June, 1911, I briefly told the

Photo by Charles D. Walcott

PREPARING PTARMIGAN SKINS TO SEND TO THE U. S. NATIONAL MUSEUM

story of "A Geologist's Paradise" along the line of the Canadian Pacific Railway. During the summer of 1911 a Smithsonian expedition, in coöperation with Mr. Arthur O. Wheeler, of the Alpine Club of Canada, visited the Robson Peak district. Mr. Wheeler went to make a topographic map, and the Smithsonian party sought to obtain specimens of the animal and plant life. The resulting Wheeler map is the best one of the region, and the Smithsonian collections were enriched by a fine series of animals that include caribou, mountain sheep and goat, grizzly and black bear, many smaller animals, birds, and also many plants.

My son Charles brought back a few Cambrian fossils picked up while hunting, and told me that ridge after ridge encircled the great Robson Peak with rocky layers, all sloping back toward the mountain. This suggested an opportunity to study another great section of the Cambrian of the Rockies 200 miles (328.8 kilometers) northwest of the section of 1910.

With our party in 1912 we had Mr. Harry H. Blagden, who accompanied the expedition in 1911; also Mr. R. C. W. Lett, of the Grand Trunk Pacific Railway, who took many fine photographs the first two weeks of the trip; Sidney S. Walcott, Closson Otto, Dr. I. F. Burgin, and Arthur Brown, all of whom were qualified by experience and physiqué to overcome the physical obstacles and hardships of the trip.

Through the courtesy of Mr. Lett, of the Grand Trunk Pacific Railway, a set of his photographs were sent to me for use in illustrating the Robson Peak district.

WHERE THE GREAT PANORAMA WAS MADE

As we crossed the beautiful Moose Pass on the Coleman trail of 1908 (6,700

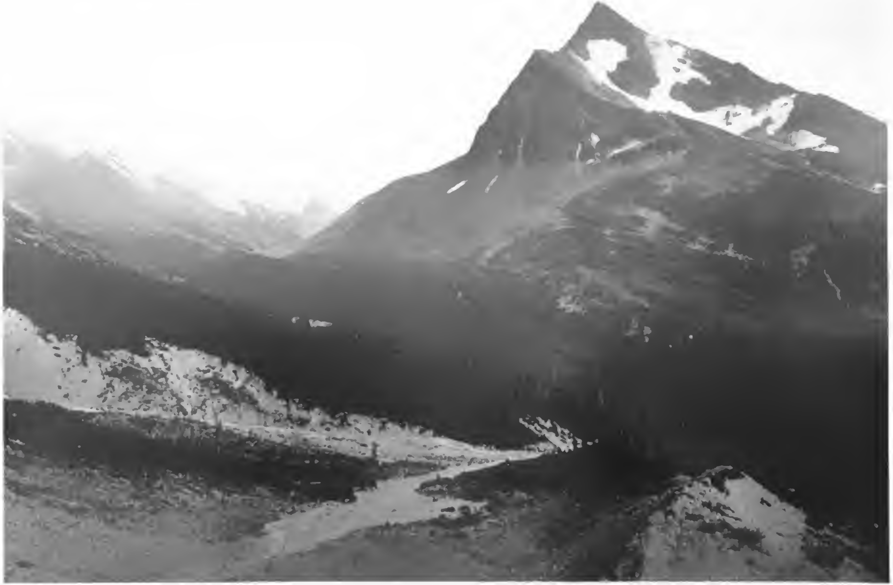

Photo by R. C. W. Lett, by courtesy of Grand Trunk Pacific Railway

VIEW OF MOOSE PASS AND TAH PEAK (SEE PAGES 629 AND 635) : OUR CAMP WAS IN THE FOREST ON THE RIGHT

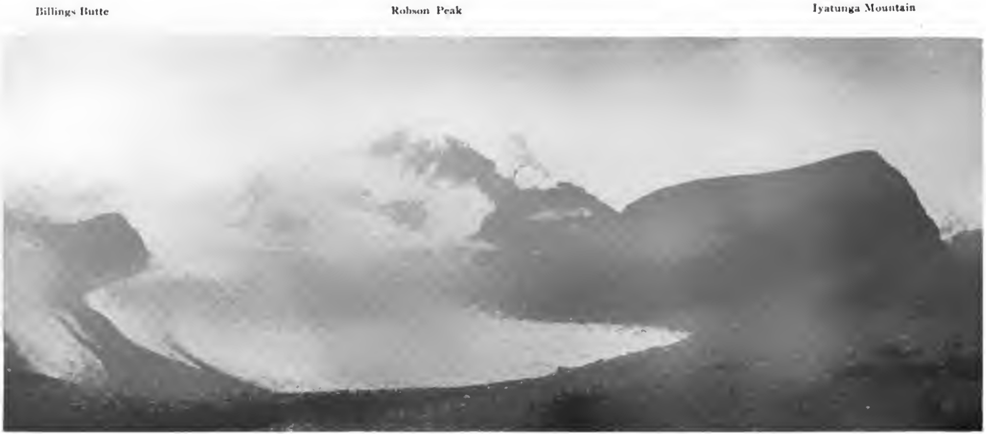

Photo by Charles D. Walcott

PANORAMIC VIEW OF THE ROBSON MASSIF AND ADJOINING MOUNTAINS, WITH THE GREAT HUNGA GLACIER IN THE FOREGROUND

The photograph was taken from a point nearly 2,000 feet above the glacier on the slope of Titkana Peak, shown in the Panorama which is published as a Supplement to this number of the National Geographic Magazine

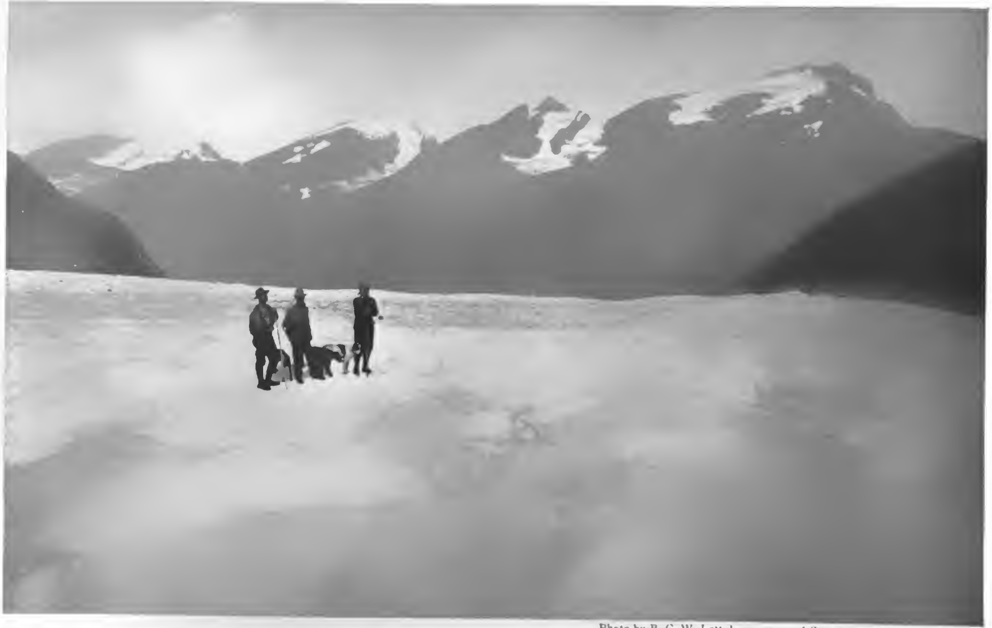

Photo by R. C. W. Lett, by courtesy of Grand Trunk Pacific Railway

THE HUMMOCKY SURFACE OF HUNGA GLACIER: HUNTING PARTY LOOKING FOR GOAT ON THE SLOPE OF TITKANA PEAK

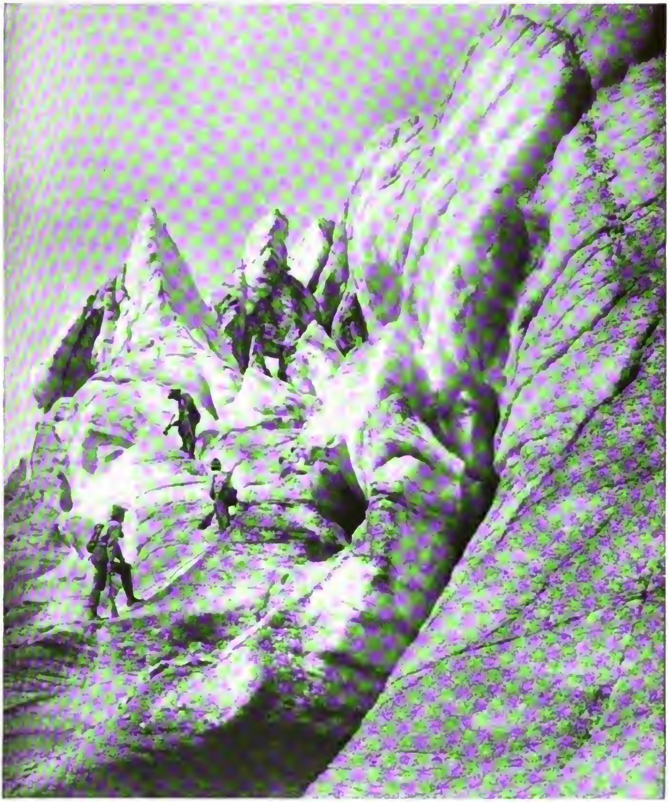

Photo by R. C. W. Lett, by courtesy of Grand Trunk Pacific Railway

WORKING UP THROUGH THE VAST AND BROKEN FRONT OF HUNGA GLACIER

"Day after day we passed between these portals and climbed over the crevassed and hummocky ice in order to trace the connection of the rocky section of Titkana Peak with that of Robson. Thanks to the fine fossil fauna found in Billings Butte, and the slope of the layers of rock, a satisfactory 'tie' was made across the glacier to the limestones of Robson" (see text, page 638).

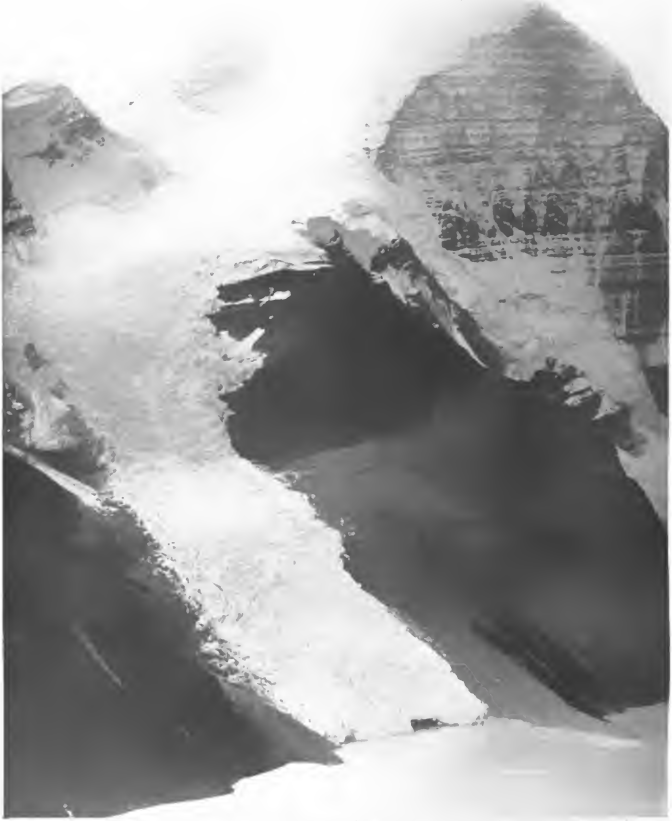

Photo by R. C. W. Lett, by courtesy of Grand Trunk Pacific Railway

VIEW OF BLUE OR TUMBLING GLACIER FROM ITS NÉVÉ ON THE SLOPE OF ROBSON PEAK TO WHERE ITS FOOT ENTERS BERG LAKE, A DESCENT OF 5,000 FEET

"Blue Glacier is a wonderful stream of slipping, sheering, blue, green, and white ice. Why it does not slip and slide as a whole down into Berg Lake is one of the unsolved secrets of this great mountain" (see text, page 638).

Photo by R. C. W. Lett, by courtesy of Grand Trunk Pacific Railway

A CATCH OF GOAT ON THE SLOPE OF TITKANA PEAK BELOW SNOWBIRD PASS

feet = 2,042 meters) (see page 630), I noted that the pass was on the line of a fault that had displaced and tilted up a great block of limestones and shales. Climbing a high point, Robson Peak was seen far to the southwest, with several high ridges between the pass and the peak. As the work went on from Moose Pass camp, mountains, ridges, lakes, great snow fields, and glaciers were examined, and finally we camped in the forest of Robson Pass, near the shore of Berg Lake, at the foot of the crowning glory of all—Robson Peak.

The view of Robson and its glaciers from above our camp is one of the finest views of a mountain mass that I have ever seen. By a happy combination of fair weather and a kindly disposed Al-Vista camera, the great photograph accompanying this paper was secured, and through the enterprise of your Editor it is given to all the readers of the NATIONAL GEOGRAPHIC MAGAZINE (see Supplement of this number). When the exposure was made, the camera stood on the south slope of Mumm Peak, about 1,800 feet (548.6 meters) above Berg Lake. The horses are near the edge of a cliff overlooking the lake.

Robson Peak rises majestically cliff on cliff for 7,000 feet (2,136 meters) above Berg Lake to its summit, where the vapors from the Pacific gather nearly every day of the year. At times the peak stands out clear, sharp, and glistening against the pure blue sky, but usually the mist gathers and trails about it in wisps, streamers, or solid clouds that often clothe the mountain in a mantle of white to its base.

Again, about Robson and on the summit of its northern spur—Iyatunga (black rock) (see Panorama)—the mists will gather as though impelled by a cyclone funneled from the mountain top, suggesting a great volcano belching forth smoke and steam far and near.

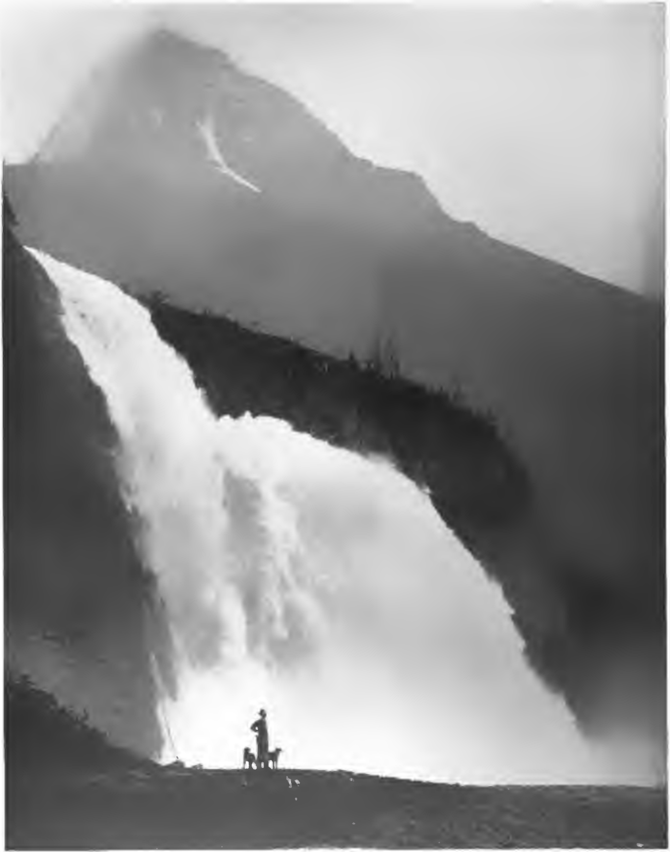

Photo by R. C. W. Lett, by courtesy of Grand Trunk Pacific Railway

EMPEROR FALLS, WITH ROBSON PEAK ABOVE (SEE PAGE 639)

"The waters flowing from beneath Hunga Glacier form two streams, one on either side of a rocky knoll near the left face adjoining Titkana Peak. The stream at the right has formed a broad delta at the head of Berg Lake, from which the water passes through the lake and out at its foot over the cliffs into Grand Fork River, and thence by Fraser River to the Pacific."

Photo by R. C. W. Lett, by courtesy of Grand Trunk Pacific Railway

WORKING ON THE GEOLOGICAL SECTION OF THE ROBSON DISTRICT

"The geologic story of this enchanting region is too long and complicated to be related here. Suffice it that I found over 12,000 feet in thickness of Cambrian beds capped by 3,000 feet or more of Ordovician strata high up on Robson Peak" (see text, page 639).

THE GREAT GLACIERS ON THE MOUNTAIN

The profile of the peak on the northwest (about 45°) is finely shown in the great photograph. On the western side the slope is 8,800 feet (2,679 meters) from the summit to the floor of the valley above Lake Kinney. On the east and southeast the upper 3,000 feet (947.4 meters) are very precipitous, but on the more gentle slopes below, the snow gathers to form the névé of the great Hunga (Chief) Glacier.

The snow clings to the steep sides of the upper peak in long ribbons quite to the crest; gathering below, it forms a névé, which pushes out and divides into two streams of ice that fall and slip down the steep inclines for nearly a mile. The stream on the left forms Blue Glacier* and on the right Chupo (mist) Glacier. Blue Glacier extends two miles (3.2 kilometers) in horizontal distance and has 7,000 feet (2,210 meters) vertical descent between the snow cornices of Robson and its foot, where the ice is thrust into the water to break off and float away as small bergs. Blue Glacier is a wonderful stream of slipping, sheering, blue, green, and white ice. The details of its marvelous descent are beautifully shown on page 634. Why it does not slip and slide as a whole down into Berg Lake is one of the unsolved secrets of this great mountain.

Chupo, the glacier of fog and mist, is usually half concealed by clouds and banks of mist that form on the edge of the mountain and drift over it. It is not comparable in size and beauty with Blue Glacier, but it proved of great interest and service to us in our geologic work. On its surface blocks of rock from high up on the peak were carried down to the great moraine at its foot, and in those blocks I found the evidence that proved the upper third of the mountain to be of post-Cambrian age by the presence in the limestones of marine shells and fragments of crab-like animals that lived in so-called Ordovician time.

Directly above Blue Glacier a point of rock was named by Dr. Coleman "The Helmet," and the great black mountain in the center, which he called the "Rearguard," is now given the Indian name of Iyatunga (black rock). Four thousand feet (1,263.1 meters) lower than Robson, Iyatunga rises dark and massive above the milky white Berg Lake and the great ice river on its left.

A FLOWING RIVER OF ICE

The beautiful Hunga Glacier is literally a flowing river of ice. In the large photograph (see Supplement) we see nearly three miles of the length of this glacier, and on page 632 its upper half of névé and tributary fields and slopes of snow and ice are shown from Mount Resplendent to Robson. At the foot of Hunga Glacier, on the left, Titkana* (bird) Peak rises as a black limestone mass that with Iyatunga* forms the mighty portals of the great glacier.

Day after day we passed between these portals and climbed over the crevassed and hummocky ice (see page 633) in order to trace the connection of the rocky section of Titkana Peak with that of Robson. Thanks to the fine fossil fauna found in Billings Butte, and the slope of the layers of rock, a satisfactory "tie" was made across the glacier to the limestones of Robson.

The work was trying and tedious, but Nature kindly assisted by bringing down long trains of boulders on the ice of the glacier. From these was revealed the story concealed in the cliffs far above, and thus we learned the geologic history of the rocks connected with that of the more accessible cliffs on the opposite side of the glacier.

Back on the horizon line between Iyatunga and Titkana there is a fine point that I am calling Phillips Mountain, in recognition of Donald Phillips, who made the ascent of Robson with Dr. Kinney. From its crest a glacier slopes down for a mile and a half to the edge of the cliffs west of Snowbird Pass. It is such a fine example of a small and complete glacier from névé to foot that I think it worthy of the name Chushina.

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* Coleman. Account of expedition of 1908.

* Names approved by Geographic Board of Canada, December, 1912.

It was along the slopes below this glacier that our party met a band of mountain goat, affording museum specimens as well as food for hungry men and dogs at camp (see page 635).

THE STREAMS THAT FLOW FROM THE GLACIERS

The waters flowing from beneath Hunga Glacier form two streams, one on either side of a rocky knoll near the left face adjoining Titkana Peak. The stream at the right has formed a broad delta at the head of Berg Lake, from which the water passes through the lake and out at its foot over the cliffs (see page 636) into Grand Forks River, and thence by Fraser River to the Pacific.

On the left the second stream finds its way to Adolphus Lake, and thence down the Smoky, Peace, and Slave rivers to Great Slave Lake and out through the Mackenzie River to the Arctic Ocean. Sometimes the water of the left-hand stream flows across the broad flat of Robson Pass at the foot of the glacier and enters Berg Lake. On warm days the surface streams on the glacier part and send their waters to the two streams below.

The geologic story of this enchanting region is too long and complicated to be related here. Suffice it that I found (see page 637) over 12,000 feet in thickness of Cambrian beds capped by 3,000 feet or more of Ordovician strata high up on Robson Peak.

A new fossil find was made by chance. Mr. Harry Blagden and I were sitting on a huge block of rock at the lower end of Mural Glacier, munching our cold luncheon, when I happened to notice a block of black, shaly rock lying on the ice. Wishing to warm up, for the mist drifting over the ice was cold and wet, I crossed to the block and split it open. On the parting there were several entire trilobites belonging to new species of a new subfauna of the Lower Cambrian fauna.

There were also some fine marine shells of a kind that occurs in the Lower Cambrian rocks west of St. Petersburg, Russia. We found the bed from which this block had come by carefully tracing fragments of the shale scattered on the upward-sloping surface of the ice to a cliff two miles away. Working until late in the afternoon, we carried all we could pack of the rock over the glacier and down through the cliffs to the valley of the Smoky River.

One of our horses had taken leave on his own account, so we loaded faithful Billy with the rock specimens, two rifles, two shotguns, a camera, and our raincoats, and plodded over the muddy trails, forded two icy-cold rivers, and "dropped in" at camp three hours after dark. At the last ford the powerful animal carried us both and all our impedimenta through the broad, rushing glacial stream.

If all is well, I hope to return during the summer of 1913 and spend many weeks in the midst of this area of the "Geologist's Paradise." Meantime if any readers of the National Geographic Magazine wish to visit Robson Peak, they can readily do so by going to Edmonton and thence by railroad to Mount Robson Station, which is in sight of Robson Peak. The Alpine Club of Canada is planning to have its next summer camp on the shores of Berg Lake, and soon this wonderland will be open to all who love the mountains and the outdoor life.

A limited number of copies of Dr. Walcott's beautiful panorama of Mount Robson and its glaciers, which is published as a Supplement to this number, have been printed on heavy artist's paper suitable for framing, and may be obtained, unfolded, at 50 cents per copy at the office of the National Geographic Society.

The panorama was engraved and printed by the Matthews-Northrup Company of Buffalo, New York.

Photo by Ethan C. Le Munyon

PASSING THROUGH THE NATIVE STREET OF KALGAN

The foreigner on the horse is Mr. Heininger, a missionary of Kalgan, who kindly helped to keep the curious natives clear of the car when it passed through the main street of Kalgan. They had never before seen a motor-car.

Photo by Ethan C. Le Munyon

INTERESTED CHINESE GATHERED AROUND THE CAR

Some of them termed it a "che chu" (breath cart), and all wanted to know what made it go

THE LAMA'S MOTOR-CAR

A Trip Across the Gobi Desert by Motor-Car

By Ethan C. Le Munyon

OF ALL the strange places and strange people into whose hands American motor-cars find their way, perhaps the strangest or least known of all is "Gigin," whom all Mongolians call "The Living God," or "Bogdo."

This personage is known among foreigners as the "Tasha Lama," or Living Buddha; he is second only to the Dalai Lama of Tibet in importance in Lamaism. In Mongolia he is both the religious and the political head of the country and is recognized and venerated by all the inhabitants of Mongolia as sacred.

The city of Urga, where he dwells, has, up to recent years, been one of the cities of Asia forbidden to the foreign traveler, it being second in importance to the forbidden city of Lhasa, Tibet, the dwelling-place of the Dalai Lama and the capital of the northern Buddhist faith.

Some months ago an American firm in Tientsin, China, was commissioned by the agent of the Buddha to obtain for him a closed type of motor-car, the Buddha having heard it rumored among his priests, or lamas, in Urga that such things could be obtained from the foreigners.

After giving the matter due consideration as to the make of car best suited to the needs of the Buddha, whom we shall call "The God," as it is by that name that he is known in China and Mongolia, a popular-priced American motor-car, having the planetary type of transmission and foot control, was selected as being as near "fool-proof" as possible and best suited to the god's needs.

This type of car was chosen as being fitted to the country in which it was to be used, and also because it could be easily maintained by people who had no mechanical knowledge whatever.

The car was ordered by cable from the Detroit manufacturers and was to be a regular stock car and not a special car in any way.

Photo by Ethan C. Le Munyon

SAVING GASOLINE BEFORE REACHING THE HILL

As long as we had to have the bullocks on the hill we used them here

Photo by Ethan C. Le Munyon

STARTING UP THE "HAN OR" HILL: NOT A PLEASANT OUTLOOK

Note the camel caravan, which is loaded with cigarettes en route from Kalgan to Urga. It will take this caravan 30 days to make the trip. Each camel will carry about 300 pounds, the freight rate in this case being about 13 taels per camel, about $7.75 for the trip.

It was received in Tientsin during the last week of September, 1912, and was set up and placed in working order immediately and driven round the streets for two or three days to test out the working parts. It was then placed on a flat car and shipped by rail to the end of the Peking-Kalgan Railway at Kalgan, the point nearest the Gobi Desert, over which it was necessary to pass to reach Urga.

The car arrived at Kalgan without incident on the afternoon of the 22nd, and was unloaded at the station and driven through the native streets under its own power, across the old stone bridge and through the crowded part of the town. The natives crowded around and it was with difficulty that we were able to move without running over some of them, as they filled the road, for in almost every case they had never seen a motor-car before and a great number had never even heard of one. One and all, they wanted to know what made it go, like the old Chinaman in the early days of railroads: "No pullee, no pushee, how fashion can makee goee."

Many hundreds of years ago these streets were originally paved with huge slabs of stone, but during the passing centuries holes have been worn in and between these stone blocks, so that in some places the wheels of the car would drop into holes 12 to 18 inches deep, and in most cases they were filled with slippery mud.

USING A RIVER-BED AS A ROAD

Leaving the city behind us, we now began the climb up the pass, the river-bed serving us as a road for about 20 miles. It was necessary for us to cross and recross the stream from time to time, for the river-bed was full of loose stone, soft gravel, interspersed with larger stones, which made progress exceedingly difficult. The grade was so steep and the road so poor we were forced to use low gear most of the way, and darkness overtook us before we had gone six miles.

To add to our discomfort, it now be-

Photo by Ethan C. Le Munyon

A SCENE NEAR THE TOP OF THE PASS

We passed these caravans frequently while in the pass

gan to rain a little; so we sought shelter at a Chinese inn for the night. A trained nurse, who was going up country with us for a distance of 90 miles, used the car as a shelter; but my companion and I managed to get in a sort of stable, covered with a leaky roof, and by using a heavy canvas which we carried, contrived to keep dry and to sleep a little occasionally.

The rain continued steadily during the night, and daylight the following morning gave very little promise of better weather. We arranged with some Chinese farmers to supply us with five bullocks to draw the car in case the river-bed should prove too soft for us to run under our own power.

About 10 o'clock the clouds lifted, the bullocks were attached to the car, and we set off up the pass, saving our own power for the bad places which the natives informed us we should run across later in the day.

It was sometimes necessary to use the entire power of the car in addition to the pulling power of the five animals to get over some of the steepest places. The road was slippery with mud, and with the loose stones and large boulders, it was almost impossible for the wheels to get a grip at all. Half way up we halted at the "Temple to the Horse" and gave the animals and ourselves a rest.

THE WATCH-TOWERS OF THE GREAT WALL OF CHINA

Looking back toward China, we could see in the distance the watch-towers of the Great Wall. These are 20 miles outside the wall proper, but were built at the same time; they are at least 150 feet square at the base and quite high.

After leaving the temple the road became even steeper and filled with sharp stones and larger rocks, so that in some places it was necessary to leave the road, wending our way in and out among the larger rocks.

Near the top the worst roads of all were passed. At times it was necessary for my companion to go ahead and sound each of the mud-holes as to depth before we attempted to go through with the car. Often he had to stand on the running-board of the car to keep it from tipping over, as the road along the side of the hill was merely a sketch and the outside

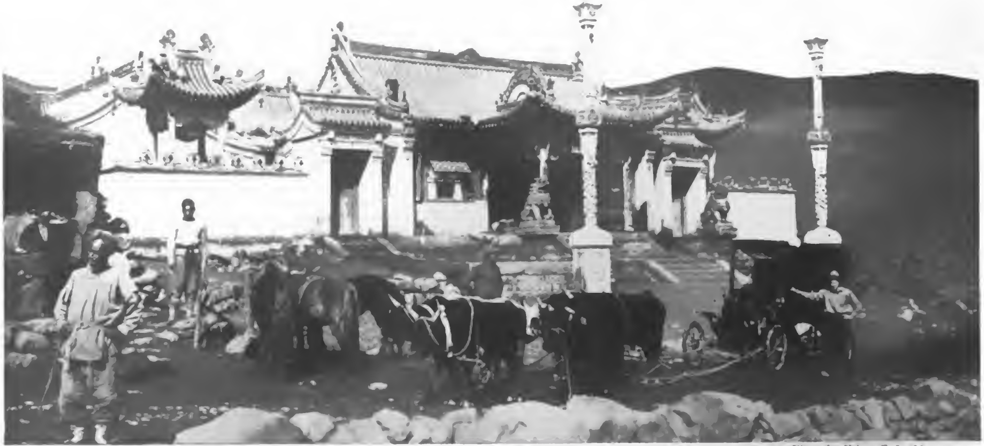

Photo by Ethan C. Le Munyon

THE "TEMPLE TO THE HORSE"

It is located about half way up the famous "Han Or" Hill, where it was necessary to use five bullocks as well as the power of the car to make the grade. The upright poles in front of the temple are of carved solid stone, the entire temple being built of stone and native brick laid in lime mortar.

Photo by Ethan C. Le Munyon

THE OVERLAND FREIGHT CARRIERS OF ASIA

Note that the road is not a boulevard even here

track was in most cases 6 to 12 inches lower than the inside; so that the car was always on the verge of upsetting.

One of the native carts which passed us had two bullocks and two Mongolian horses hitched to it, while it carried only about 100 to 150 pounds of goods. Even with all this motive power, it was all the driver could do to get up the hill, the grade was so steep.

After crossing a sea of mud, where the ruts were not less than 8 inches deep, we arrived at a native inn. We ran the car in the yard, which was also deep in mud and refuse. Here, as at the first inn, after a great deal of "dickering" with the inn-keeper, we were given a room to ourselves.

MAKING A BED IN A CHINESE INN

In this room were several bundles of garlic and onions, pack-bags, and stores in general. There was also a "kang" (or brick bed), with a hole in the center as big as a wash-tub. After filling this hole with some of the saddlebags, we spread our ground cloth over it and made a bed. This room was next the regular room of the inn, which was about 10 by 15 feet in size, and contained one very large brick kang, on which slept about 20 Chinese and Mongols, which to us would seem impossible; but the fact remains, however, that this was the true number. After listening for a while to their jabbering, which continued all through the night, we tried to sleep, but had rather indifferent success.

The following morning we did not attempt to get an early start, as we wished the roads to dry a little if possible. We also waited for our second carter to arrive from Kalgan. The first, who was carrying our extra baggage, had only been engaged to go as far as this, for we had been told in Kalgan that the roads would be hard and dry from this point on, which they certainly were not. Carter number two put in appearance about 11 o'clock; the baggage was transferred to his cart and a start made.

During the remaining hours of daylight we made as much progress as possible, arriving at a small Chinese settlement by the name of "Meeota" (temple), where we spent the night in a much better inn.

This was a very interesting day's run, as we passed through a section of cultivated Chinese fields where grain was

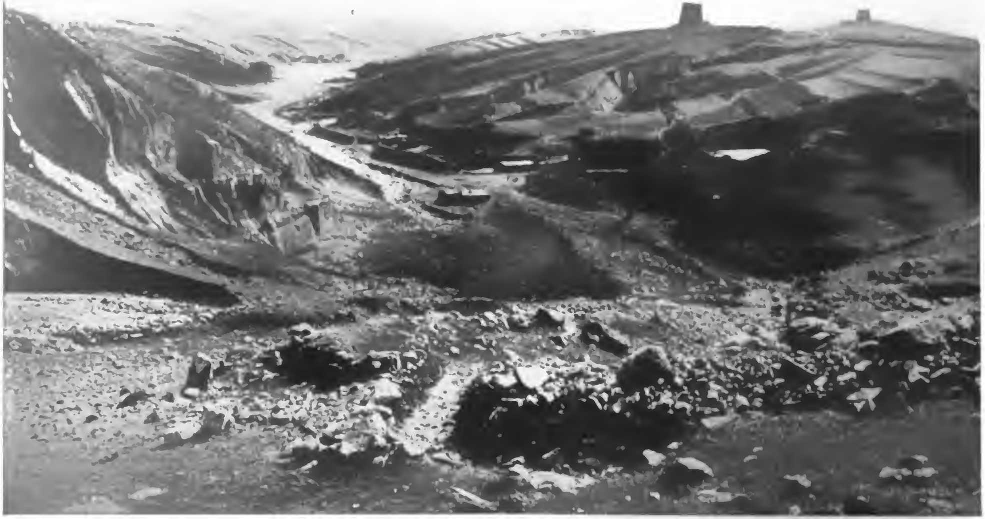

Photo by Ethan C. Le Munyon

LOOKING BACKWARD DOWN THE PASS

The square towers on the sky-line are the last outposts or watch-towers and were built at the same time as the Great Wall. It is hard to realize that for 2,000 years they have stood in this position, a monument to the master mind who conceived the greatest work of man in Asia, for the Great Wall of China, with a length of over 2,000 miles, is truly one of the greatest wonders of the world. The wool, fur, and skin trade of all Mongolia enters China through this pass.

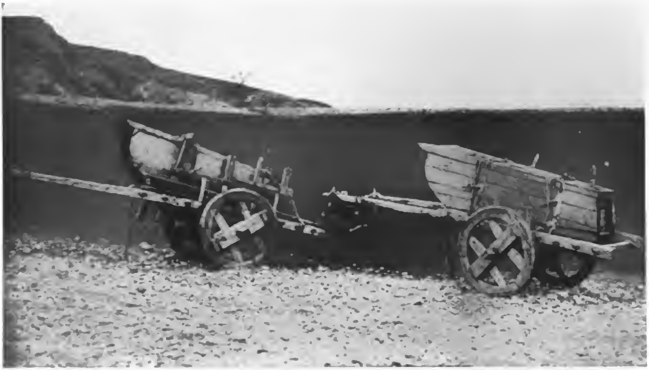

Photo by Ethan C. Le Munyon

CHINESE COFFINS LOADED ON CARTS AND STANDING JUST OUTSIDE THE INN YARD

Note that the wheels of the carts are of wood only and have no iron tires. In fact, no iron is used, wooden pegs serving the same purpose as nails

growing. There was a great collection of sheep and camels in the inn yard awaiting shipment to China. When we were leaving the following morning, all the women of the town lined up at the gate.

The country through which we were now passing was an almost flat plain, with rolling hills showing against the horizon. The soil in this section was also very poor, free alkali showing in many places, and the grasses and bush were not unlike those of our own great Southwest. We were now beyond the cultivated region and were entering the barren country at the beginning of the Gobi Desert.

THOUGHTFUL PROVISION FOR GHOSTS

Soon after we passed a couple of Chinese graves, each of which had a small hole in the end, so that the spirit could pass in and out at will.

About noon we came in sight of the last river which we would have to cross. We made a run for it and got as far as the middle of the stream, but the mud in the bottom got the best of us and we stuck. We were, however, prepared for just such a case as this, and had provided the car with a set of small iron tackle blocks before leaving Tientsin, and carried an iron rod, which was driven in the dry bank of the stream; and as we had a long length of rope, it was only necessary for us to thread up the pulley blocks and to pull the car out, with the help of a couple of Mongols who happened to come along at that time. When we stuck in the stream the water was over the muffler, and we did not dare stop the engine lest we could not start again, as the water was just to the bottom of the carbureter.

We were now freed from troubles of this sort until we reached the Tola River, just in sight of Urga. As we had plenty of water here we washed the car, removing some of the mud, which stuck like cement, as it had been on for three days from the time we entered the wet clay on the way up the pass. We had lunch and drove on about a mile further, where our carter came up with us and unloaded our baggage. We paid him off in lumps of silver, called "sycee," which was weighed out in small pocket scales, which are always carried when traveling in Mongolia. The baggage was now transferred to the machine and, after giving

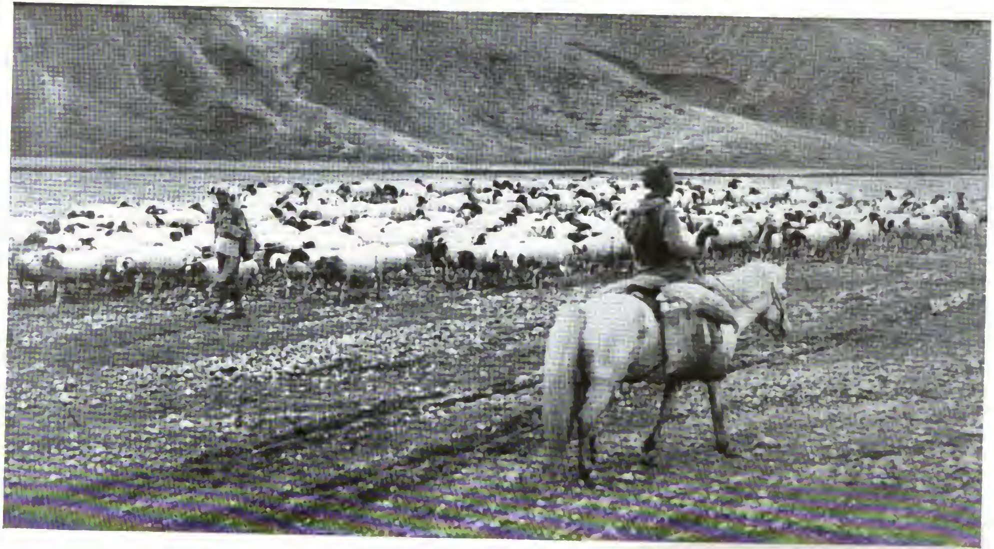

Photo by Ethan C. Le Munyon

MUTTON BOUND FOR PEKING VIA KALGAN

It is driven in on the hoof, the skins and the wool in many cases being shipped to America. This wool is suitable only for carpet use. The larger percentage of carpet wools come from China

Photo by Ethan C. Le Munyon

TRANSFERRING THE BAGGAGE FROM THE CHINESE CART TO THE AUTOMOBILE; ALSO SETTLING WITH THE CARTER FOR HIS SERVICES

The foreigner in the white shirt—my companion on the trip—is weighing out the lump silver (*sycee*) to pay the carter the proper amount. The lady in the picture is a trained nurse who traveled a distance of 90 miles into Mongolia to call on some friends. This is the place where we bade farewell to the Chinese. The roads are much better here, hard but very rough. With our additional baggage we had a very heavy load.

trade tobacco to some of the Mongols who had assisted us, we took to the road again. The roads were now in much better shape; they were dry and not very smooth, but this was much better than mud.

Soon we stopped at a well to replenish our water supply. This was a dug well about 70 feet deep. The bucket was a piece of untanned bullock hide, with the hair on the inside, and every time we drew water some of the hair would come off. Americans might not consider it quite sanitary.

The days are warm and sunny here, but the nights are so cold that it was necessary for us to drain the radiator of the car to keep the pipes from bursting. From that time on we had to do this every night until we reached Urga.

Late on the following day we passed over a level plain and several herds of antelope were sighted; they were scared at the motor-car and we could not get very near to them. Soon we entered the barren plain and stopped the car to speak to the driver of a camel-cart.

THE OVERLAND LIMITED OF THE DESERT

These camel-carts are the "overland limited" of the desert and are used as passenger conveyances. The body of the cart is covered with heavy felt, which will defy the coldest weather, and in all they are quite comfortable, if one can only forget that there are no springs under them.

Pangkiang, the first telegraph station, was reached about dark. Here we found the first 10 gallons of the gasoline which we had sent forward from Tientsin a couple of weeks before shipping the car. The supply was transhipped at Kalgan and forwarded to Urga by camel cara-

Photo by Ethan C. Le Munyon

A CHINESE INN YARD: MONGOLIA

This is where all travelers in this part of the country have to stay over night if they want a roof over their heads, poor as it may seem. The Chinese are yearly moving farther and farther into Mongolia, raising grain and other food-stuffs. The Chinese cultivated fields extend outward into Mongolia about 70 miles from Kalgan. While the season is quite short, the soil is very rich and productive and will support many of the millions who at present live in the crowded cities and villages of China.

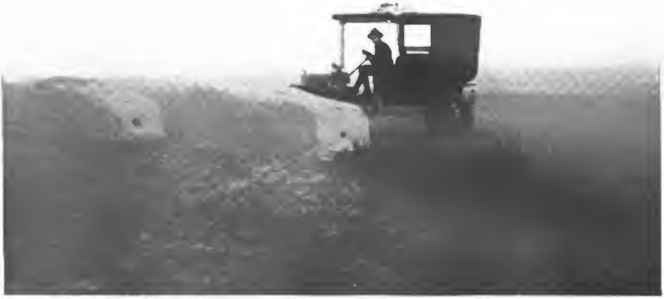

Photo by Ethan C. Le Munyon

CHINESE GRAVES NEAR THE ROAD

The hole is to let the spirit of the deceased in and out at will. This is a rather lonesome place—a sort of alkali country

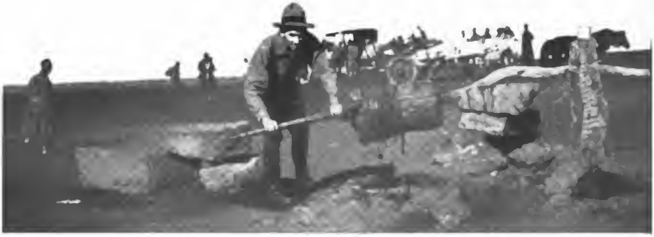

Photo by Ethan C. Le Munyon

THE WRITER DRAWING A BUCKET OF WATER AT A NATIVE MONGOL WELL

The windlass and rope are removed from the stone-post and taken into the tent of the Mongol owning the well. Wood is very scarce, and it would never do to leave this amount where it could be stolen. The bucket in this instance is a piece of untanned cowhide with the hair left on, and on the inside of the bucket too. The hide is sewed up the side and holds probably two American gallons. Of course a quantity of hair comes out each time the bucket is emptied. As this one had been in use some time, the odor was not pleasant. However, it was the only way to get water and we had to have it. The well is a dug well, about 70 feet in depth.

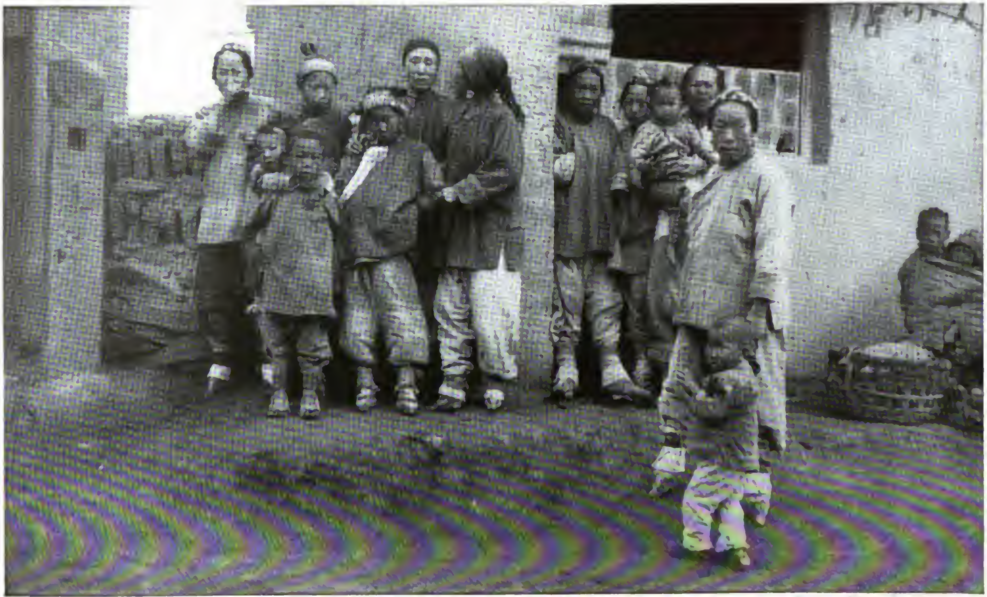

Photo by Ethan C. Le Munyon

A GROUP OF NATIVE CHINESE WOMEN AT THE LAST CHINESE SETTLEMENT, CALLED "MEEOTA," WHERE THERE WAS AN INN: NOTE THE SMALL FEET van, with instructions that a tin of 10 gallons was to be left at each of the three telegraph stations, which were about an equal distance apart across the desert.

The Chinese who was in charge of this office spoke English and entertained us in the guest-room, which is always reserved for officials traveling on government business in Mongolia. The Chinese government operate a telegraph line across the desert from Kalgan, in China, to Kiachtka, in Siberia. The altitude at this point is 5,600 feet. We were now 180 miles from Kalgan, and in this one day we had made a distance of 90 miles.

We were now on the actual Gobi Desert, and at times found the roads very, very sandy, so that it was impossible to make good time. At a well we took a few photos of the native women and also of a lama. The lamas have their heads shaved, but the ordinary Mongols wear a queue like the Chinese. Their features are very different from the Chinese and both sexes are filthy beyond description. About 98 per cent of these natives never bathe from the cradle to the grave.

Photo by Ethan C. Le Munyon

A TYPICAL MONGOLIAN LAMA: THESE LAMAS ARE THE PARASITES OF MONGOLIA

Later in the day we came upon a Mongolian temple, which was patterned more after the Tibetan style of architecture. There were a great many dirty lamas living there.

THE TELEGRAPH IN THE DESERT

Night overtook us when we were passing through a very bad stretch of rocky, mountainous country, and, rather than risk the car and our necks, we stopped the car at the side of the road and spent the night where we were.

Udde, the second telegraph station, located at an altitude of 3,000 feet and situated at the foot of a small mountain almost in the exact center of the desert, was the next stopping place; it was 328 miles from Kalgan. Here we disconnected the muffler from the car, as we had no "cut-out," so that if it was possible to save fuel and keep the engine cool we could try our best to do so. That afternoon we traveled on some comparatively good roads, but as they were full of small holes, fast running was out of the question. About dark we came up with a caravan and spent the night in one of their tents, we having none.

The following day we disturbed several herds of antelope and managed to get one. We estimated that in one of the

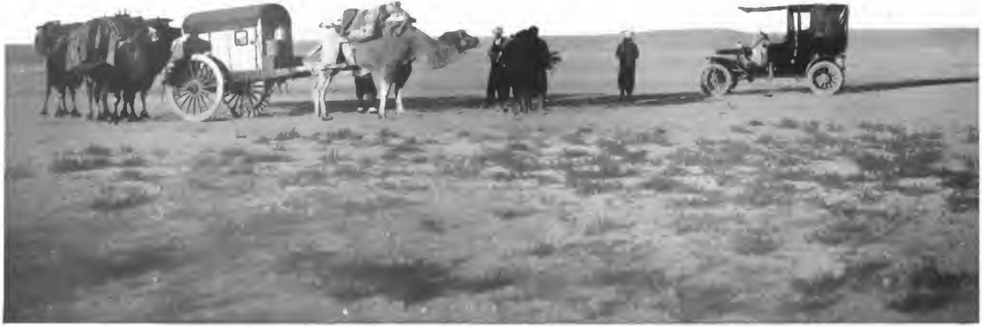

Photo by Ethan C. Le Munyon

THE OLD AND THE NEW

A unique picture and probably the only one of its kind ever taken. The actual setting is in the middle of the Gobi Desert. The camel cart is the "Overland Limited" of the Gobi, and is the most luxurious method of transportation there. The cart is covered with heavy felt and is quite warm even in the coldest weather. It has no springs and sometimes tips over. The swaying motion is very much like a small boat in a heavy sea. The automobile here travels as far in one hour as the cart in a day. Twenty-five miles is a good day's travel for the camel cart.

Photo by Ethan C. Le Munyon

A GROUP OF CURIOUS NATIVES GATHERED AROUND THE CAR

droves there must have been at least 500. We began a climb of over five miles, to a grassy plain about 30 miles wide; here the road was scattered with the bleached bones of cattle that had died by the way and also of other animals. About dark we stuck in the sand of a river-bed and had to dig ourselves out. This caused a delay of a couple of hours, so that we were forced to sit up in the car that night, as it was raining a little and very cold, and we dare not go on, as we were, of course, not familiar with the trail, and even in daylight we lost the way two or three times, as the beaten path was not very well marked.

During the night a string of 90 bullock carts passed us, bound for Kalgan, loaded with small hewn logs to be used for lumber; this had come all the way from the other side of Urga. It would take at least 30 days for them to reach Kalgan, as they could only make about 15 to 20 miles per day, because the bullocks had to get their living from the country and, of course, had to be pastured during the daytime.

The following day we reached Sume, which consists of the two temples and their outbuildings and forms one of the largest and most important lamaseries in outer Mongolia. The altitude here is 4,800 feet. There are about 2,000 lamas living here, some quite young, as Sume is an important theological school.

This lamasery, or monastery, is a town in itself and very interesting. Lamas may be seen here of all ages and degrees of filth. On the tops and corners of the temples are prayer-wheels covered with gold leaf; these contain long prayers written on rolls of script, the wheels revolve in the wind, and the results of these special prayers are said to be as satisfactory as those offered by any other method, either ancient or modern.

WHAT THE LAMAS ARE LIKE

Every third man in Mongolia is a Lama. Some live in *yurts*, or tents, with and on their relatives, while others live in the temples. The temple lamas are of the lower type; they are coarse and filthy and much inferior, both morally and physically, to the tent lamas. They are not unlike those sometimes seen by travelers in the Lama temple at Peking, China. The lamas living in tents among the people are of a better class and are much respected and looked up to all over Mongolia.

We had now taken on our last tin of gasoline and were on the "home stretch." We had to drive against a strong head wind, and were it not for our heavy fur coats we would have suffered greatly from the cold. The wind blew so hard that on the up grades it was almost impossible to drive the car in high gear and make speed. On this high, grassy plain

Photo by Ethan C. Le Munyon

TYPICAL MONGOLIAN HORSEMEN

They are not lamas, but ordinary civilian Mongols, who own herds, tents, etc.

we saw hundreds of antelope, in groups of from 5 to 50; all became frightened, and in one case they ran ahead of the car, crossing the trail about 100 yards in front of us.

About sundown the road became very rough and hilly, and several soft places were passed over where the water came out of the ground as seepage. These places were on side hills, and all indications pointed to the fact that it would be a good place to develop water by artesian or other methods. This will be done, perhaps, when the country is settled by an agricultural people like the Chinese or the Russians. This is bound to come soon, for famines in China are driving the common people to new and more productive regions, and every year sees more and more of them in Mongolia, as well as Siberia and Manchuria.

As we saw that it would be impossible to reach Urga that night, we stopped the car near the trail and, wrapped in our fur coats and blankets, passed another night in the car.

We were now in the hills, which were at this time covered with dry grass. Dipping down into the valleys, we encountered water and very soft and marshy ground, and in going across one bad marshy place the car broke through the frozen ground and we stuck in the slippery mud. It was here necessary to wind long lengths of rope around the tires to obtain traction, and we had to

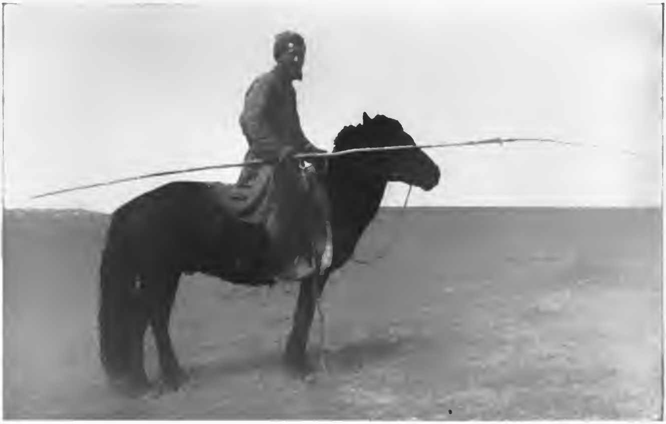

Photo by Ethan C. Le Munyon

A MONGOLIAN HORSEMAN

The pole with the slip-noose is used in place of the lariat, and is almost as effective. The rider drives into a herd and "cuts out" the horse he wants, drops the noose over his head and soon subdues him.

Photo by Ethan C. Le Munyon

CATCHING HORSES ON THE PASTURE LANDS OF MONGOLIA BY THE AID OF A POLE

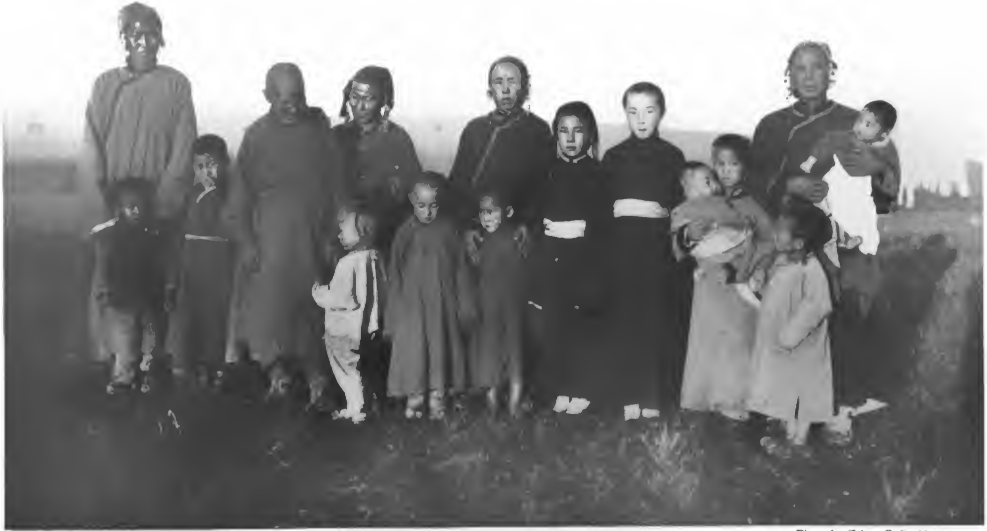

Photo by Ethan C. Le Munyon

A GROUP OF MONGOLIAN WOMEN AND CHILDREN

The second adult from the left is a Buddhist nun. These natives have been in contact with foreigners and are therefore cleaner than the average native

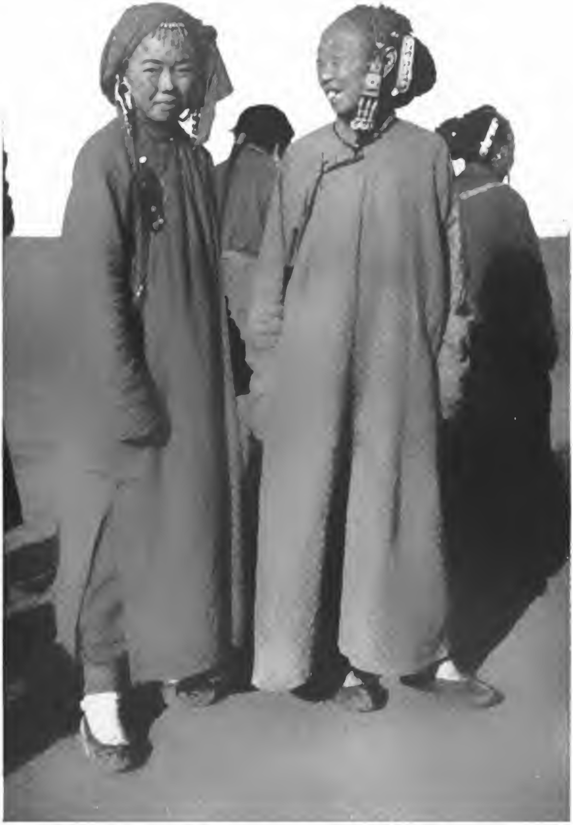

Photo by Ethan C. Le Munyon

WELL-TO-DO MONGOLIAN WOMEN OF SOUTHERN MONGOLIA

Note the heavy silver ornaments used to dress the hair. This always represents their wealth

Photo by Ethan C. Le Munyon

THE TOWN OF SUME, SHOWING THE TWO MONGOLIAN TEMPLES IN THE DISTANCE SURROUNDED BY THE SMALLER QUARTERS OF OVER 2,000 LAMAS: IT IS A SORT OF MONGOLIAN LAMA SCHOOL

dig trenches for the wheels in the mud for about 75 feet to solid ground; for if we did not do this, the wheels would spin around without moving the car.

A small lake or two were passed where we saw a great many wild-fowl. Most of the grades that we went down here were so steep that we left the clutch in, shut off the power, and went down under compression, using the brakes at the same time.

From time to time groups of native *yurts* (tents) were passed by the side of the trail. The women of this part of Mongolia dress their hair very differently from their sisters of southern or inner Mongolia. The dress of the men, however, is the same.

Arriving at the Tola River, we crossed by way of the Russian bridge, which is constructed of logs. The Tola at this point is about 300 feet wide and from 5 to 10 feet deep at that time of the year. The surrounding mountains were covered with a forest of larch. After crossing the bridge and traveling up the river-bed, fording the smaller tributaries from time to time, we arrived at the native Chinese city of Mai-Mai-Chen, which is the business place of Urga. It is about five miles east of Urga proper, where the Mongol temples and the Russian traders are located. The Chinese telegraph office and a branch of the Ta Ching Bank (government bank) are situated at Mai-Mai-Chen.

After giving the car a thorough inspection and making some needed adjustments, we washed it and covered it up, awaiting instructions from the god regarding its delivery. Time is without value among the Mongols; the higher the official, the longer it takes to

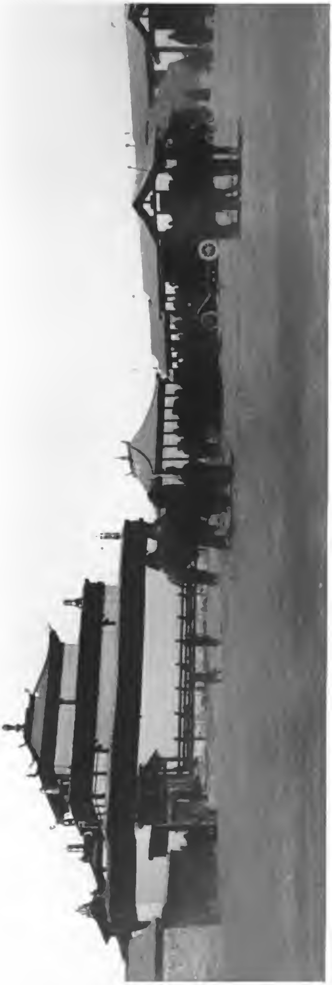

Photo by Ethan C. Le Munyon

A CLOSER VIEW OF THE SECOND TEMPLE AT SUME SEEN IN THE ILLUSTRATION ON PAGE 660

The cylinders standing upright on the roof are prayer-wheels, which are gilded with gold leaf and turn in the wind. Written prayers are put inside, which revolve and pray

deal with him, and in this case, as it was the god himself that we had business with, it would take a long time. Needless to say, the car was a seven days' wonder to the natives of Urga.

While awaiting the pleasure of the god, we wired the car so that we could drop a small chain on the ground, and when the motor was running no one could touch the car without getting a slight shock from the magneto. This afforded us quite a little fun at the expense of the natives, who could not understand what had "bit them," as they expressed it, and did not leave a mark.

As we were to see the Buddha and had brought the car all the way from China for him, we were shown great respect by the natives.

The population of Urga is hard to estimate. During the autumn and winter months there are from 20,000 to 30,000 lamas here.

There are countless temples and long lines of prayer-wheels beside the road. One temple contains the shrine of "Maidari," the future ruler of the world, an image of metal about 30 feet high, which is estimated to weigh 125 tons. It was cast in sections and brought to Urga from Dolonor, a city 600 miles east of Urga, where it was designed and cast.

The temples of Urga are many and of all kinds. Some are no more than large tents and others are resplendent in vivid colors, gold leaf, and gilt. Some follow the Chinese style, some the Tibetan, and others seem to have a sort of style common to neither.

There are few regular streets in Urga, with the exception of the main street, along which are lines of prayer-wheels, which are sheltered by small shanties or sheds. These are turned by hand by the people who wish to pray. Prayer flags float over all tents and temples and smaller prayer-wheels turn in the wind, while gilt prayer-wheels swing from the roofs of the temples.

Urga was the residence of a Chinese lieutenant governor, or "amban,"as he was called, the representative of the Chinese government. Since Mongolia declared herself independent of China, early in the year 1912, there has been no amban, the former one having fled, reasoning that he was not needed. The god was crowned Emperor of Mongolia, and as he was actually the religious head it made his position doubly secure. Whether China will ever again obtain con-

Photo by Ethan C. Le Munyon

A MONGOLIAN TEMPLE OR "SUME," TIBETAN STYLE OF ARCHITECTURE, OF PLASTERED STONE AND BRICK; AN EXCEEDINGLY DIRTY, FILTHY PLACE

Photo by Ethan C. Le Munyon

PASSING A GROUP OF WILD HORSES, COMMONLY CALLED MONGOLIAN PONIES

trol of Mongolia, time alone will tell; but for a long time Russia has cast a covetous eye on it.

The houses and business places in Urga are surrounded with stockades of large logs set on end and sharpened at the tops in some cases, while in others they are left square at the top. These stockades are 15 to 20 feet in height and afford effective protection against intruders and thieves.

A common sight in the streets of Urga is the Russian tarantass, a clumsy four-wheeled cart without springs, to which are hitched three horses abreast; they are extensively used to carry passengers between Urga and towns on the northern border.

Urga is surrounded by high mountains on all sides. One of these, Bodga Ol (Buddha's Mountain), is heavily wooded with forests of larch and no hunting is allowed. In the districts between Urga and Kiachta are extensive pine forests.

Urga is without doubt one of the very few cities seldom visited by the foreigner, as it is no holiday trying to reach it even from the Transiberian Railway. It means five or six days of continuous traveling in a tarantass and by boat, while to reach it from the China side it is necessary to cross the Gobi Desert, a distance of about 700 miles.

The street scenes are many and varied. The women ride past on swift-footed Mongol ponies. Long lines of bullock carts go by, in most cases loaded with wood from the near-by mountains. Here is also seen the Tibetan yak, used as a beast of burden. The trade of the place is in the hands of the Chinese, although there are a few Russian stores. The Russian government has a consulate here and a large garrison of soldiers. The offices of a large gold mining company are also located here, the mine being between Urga and Kiachta.

WHAT THE LIVING BUDDHA IS LIKE

About a week after our arrival the car was delivered to the god, who entertained us at lunch, if such it might be called. We drove the car inside the compound of the palace, which was a sort of stockade built of logs set on end (see page 668), and took some of his chief officials for a drive outside, which pleased them very much.

After the business of turning over the car had been completed, the god, through his head lama, presented the writer with a bolt of imperial yellow brocaded silk, wrapped in a blue silk scarf.

The god is about 40 years of age. His appearance is not prepossessing. He has a bull neck and a hard-looking face and seems more like a cut-throat than a holy pontiff. He is almost blind. It may be remarked here that blindness is a common complaint among the Mongols, and while it is usually caused by a lack of personal cleanliness, there are other causes. The fuel burned in Mongol tents is *argol*, or dried camel dung; it is burned in an open grate in the middle of the tent, and the fumes cause an irritation of the eyes as well as the lungs. This is the only fuel on the Gobi; even in Urga it is burned in place of wood, as it is cheaper.

Some years ago the Buddha was a gay young spark, and although his morals

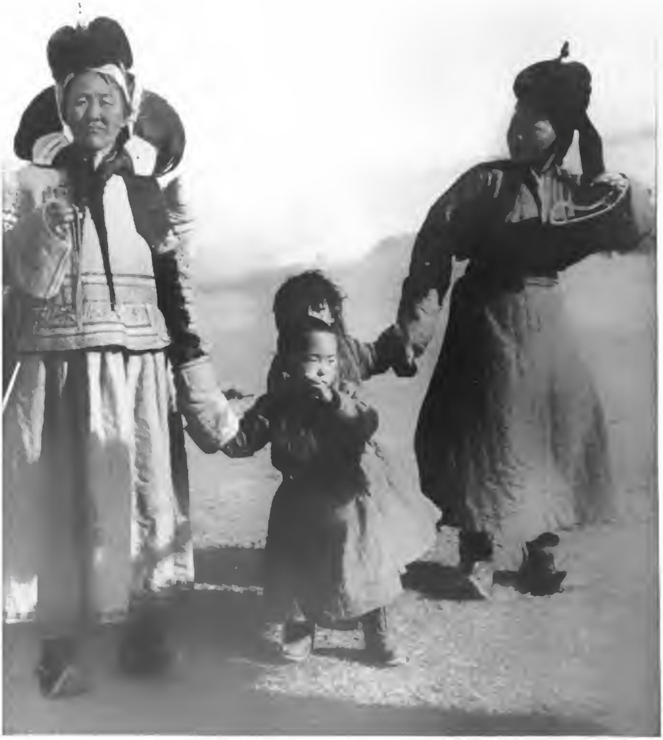

Photo by Ethan C. Le Munyon

WOMEN OF NORTHERN MONGOLIA; NOTE THE DIFFERENCE IN HAIR DRESSING AND THE PADS ON THE SHOULDERS OF THE WOMAN ON THE LEFT

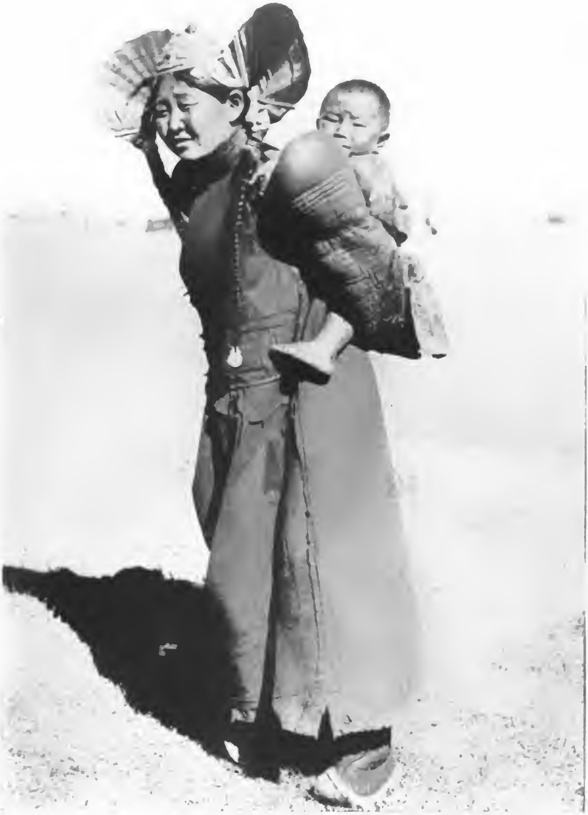

Photo by Ethan C. Le Munyon

A TYPICAL WOMAN AND CHILD OF NORTHERN MONGOLIA

Note the method of dressing the hair; also the pads on the shoulders. The head-piece is of beaten silver set with red-stones

Photo by Ethan C. Le Munyon

THE TEMPLE AT URGA WHICH CONTAINS THE SHRINE OF MAIDARI (THE FUTURE RULER OF THE WORLD): THE IMAGE IS 33 FEET HIGH AND IS ESTIMATED TO WEIGH 125 TONS (SEE PAGE 661)

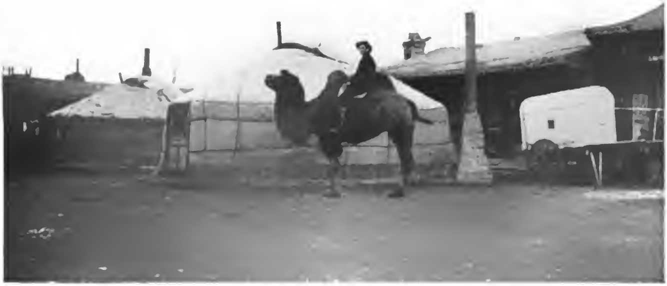

Photo by Ethan C. Le Munyon

THE WRITER OUT FOR A MORNING RIDE—MONGOL "YURTS" AND CAMEL CART IN BACKGROUND: URGA

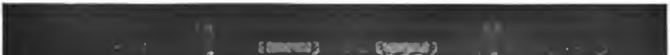

Photo by Ethan C. Le Munyon

THE MONGOL WITH WHOM THE WRITER STOPPED WHILE IN URGA: THE PHOTOGRAPH WAS TAKEN IN THIS RICH MONGOL'S COMPOUND

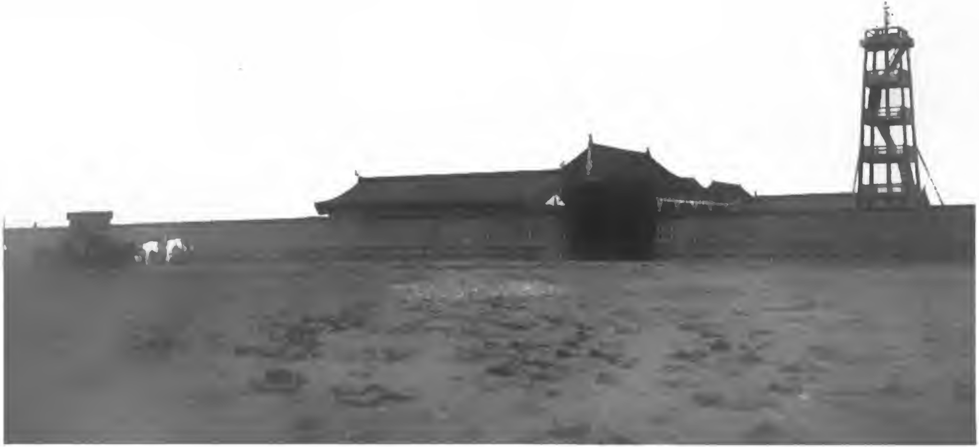

Photo by Ethan C. Le Munyon

EXTERIOR VIEW OF ONE OF THE GOD'S SUMMER PALACES, WHERE THE MOTOR-CAR WAS DELIVERED

Note that it is surmounted by a watch-tower, and is also surrounded by a palisade of logs. In the foreground is "Argol" drying camel and animal dung, which is used as fuel in this country are said to have improved since then, he has not entirely given up his former modes of life. In spite of the tenets of the Buddhist religion, which prescribe celibacy for all lamas, the god is said to be very susceptible to feminine charms, his favorite being a tall Mongol girl. It is said that her influence over her divine lord is very great. She has commercial instincts and, besides the large sums and presents which she receives, she is reported to own a store in Urga and to be fairly rich.

The god has only to express a wish and his faithful adherents compete with each other to supply his needs; whether it is a watch, a horse, motor-car, or a new concubine, one is obtained at once. At the present time he is seldom seen by foreigners. He has three palaces in Urga and spends some little time in each. One place is copied from the Russian consulate; the others are of the native type and quite imposing.

Mongolia is one of the most interesting countries in the world today and also one of the most primitive. The inhabitants in many ways resemble our own North American Indians. They have a written language, are blindly devoted to the Buddhist religion, and very fanatical. The lamas, or Buddhist monks, are the curse of Mongolia and are parasites living on the religious credulity of their lay brethren.

The highlands of Mongolia vary in altitude from 3,000 to 5,500 feet. There are many mountain ranges, and in very few places is the country level for any considerable distance. The word Gobi means a "barren or desolate plain." Vegetation is absent, with the exception of a few grasses, so that argol (or dried camel dung) is the only fuel used. It is collected and stored in large quantities for use during the winter.

Water is scarce, a few wells along the caravan route furnishing the entire supply. During the winter and spring the camel is the only animal that can cross the desert and subsist on the dried-up grasses. At this season of the year blocks of ice are carried for the water supply, and at other seasons two large tubs are carried on each camel, used for this purpose, one tub on each side of the camel.

The medium of exchange is the Chinese tael (an ounce of silver). Small squares or cubes of pressed silk are also used, but brick tea will pass current for barter in any part of Mongolia. Tobacco is also used for this purpose. The trade is in the hands of the Chinese, with the exception of the Russian traders in Urga. There is a Russian and also a Chinese post-office in Urga. Both maintain a pony express route across the Gobi; the time is 7 days.

A CURIOUS METHOD OF BURIAL

Mongols look on the dead in a different light from the Chinese, and their dead are taken just outside the town and thrown down. The dogs, sometimes those from their own tent and also others, soon make short work of them; in a couple of hours nothing is left. The natives believe that the quicker this happens, the better chance the spirit of the departed has in reaching Paradise.

The Mongol is a great meat eater, living in some cases entirely on mutton. In comparing other foods, he will ask if they are as good as mutton. It is not uncommon for a Mongol to consume 10 pounds of this meat at one sitting. He puts mutton fat in his tea, which is prepared with milk from the brick tea (poorest grade pressed in bricks), and of this he drinks enormous quantities; 30 cups per day is not an uncommon amount for an adult. There are no regular hours for eating; the native eats when opportunity offers. Game is not common near Urga, but many varieties are found in the mountains, though hunting on Bogda Ol (Buddha's Mountain) is prohibited.

After having delivered the car, we left for Kiachta and the Transiberian Railway, riding in a Russian tarantass. By traveling four days and four nights we arrived in Kiachta in time to catch the river steamer going down the river to the railway the following day. We arrived back in Tientsin after an absence of 32 days, having traveled 1,200 miles over-

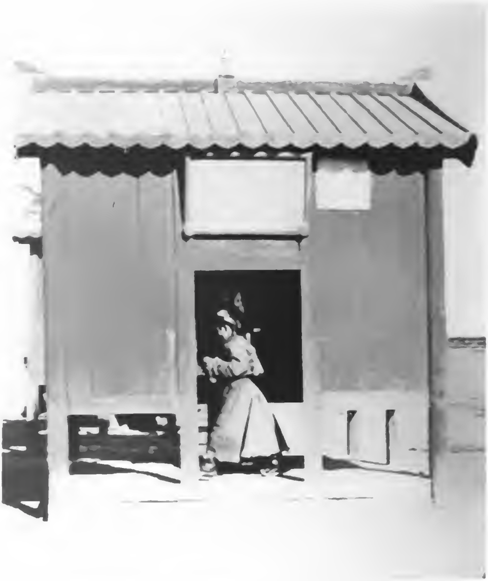

Photo by Ethan C. Le Munyon

A MONGOLIAN PRAYER-WHEEL IN THE STREETS OF URGA

This is only one of about 100 that line the main road or street. It is an octagon wheel on a vertical shaft. The pilgrim or worshiper walks around it, revolving the wheel at the same time (see page 662).

land by conveyances other than the railway. The total distance covered was 3,300 miles in 32 days, during which time for eight days no traveling was done—one day at Tob Ol and seven days in Urga; also a day and a night between Urga and the railway.

This was the first time that a closed car had ever been driven across any desert country. This was also the first car to cross the Gobi Desert, other than a racer, two racers having crossed it in the Peking to Paris race. No tire changes were made in the entire distance; leather treads protected the back tires; the front ones ran bare; there was not even a puncture. Four months after our return from Urga (February, 1913) we heard directly that the car was running and giving good satisfaction.

VOL. XXIV, NO. 6 WASHINGTON JUNE, 1913

THE NATIONAL GEOGRAPHIC MAGAZINE

A GEOGRAPHIC ACHIEVEMENT

THROUGH the courtesy of the Secretary of Agriculture, the NATIONAL GEOGRAPHIC MAGAZINE reprints on pages 669-697 of this number "Fifty Common Birds of Farm and Orchard," which was prepared under the direction of Henry W. Henshaw, Chief of the Bureau of the Biological Survey, and published as Farmers' Bulletin 513 of the U. S. Department of Agriculture. The illustrations are all from drawings made by Mr. Louis Agassiz Fuertes, the skillful painter of American birds.

To obtain the exquisite and delicate colors of the pictures, which are such faithful portrayals of the birds, the printed sheets had to pass through the presses eight times, therefore representing nearly two million impressions. This immense amount of work naturally involved a very large expense, but the NATIONAL GEOGRAPHIC MAGAZINE felt justified in spending the many thousands of dollars to republish this wonderful bulletin in order that every reader of the GEOGRAPHIC may have in the household this helpful guide and the accurate and useful information that it contains. The huge outlay required for this colored work would, however, not have been possible but for the great recent increase in the circulation of the Magazine, which has enabled us to bring the cost per copy within reach by distributing the expense over the larger edition.

With the help of these beautiful pictures and clear text the reader will be able easily to identify fifty of our common birds. While this valuable contribution will be specially serviceable in the summer months, when our readers spend more time in the open, it will prove an equally convenient introduction to some of our feathered friends throughout the entire year.

Just as remarkable as the fifty beautiful pictures is the quantity of concise information given about each individual bird, and which is the result of long study by some of the best bird men and women in America. For many years the experts of the Biological Survey have been making accurate tests to determine which birds are useful to man and which destructive. The contents of the stomachs of many thousands of specimens have been analyzed with a view of finding whether the bird helps the farmer by eating injurious insects and noxious weeds, or hurts the farmer by eating his fruits and grain.

These investigations have shown that, with rare exceptions, birds are useful everywhere, and that without their help successful agriculture would be impossible. "The activity of birds in the pursuit of insects is still further stimulated by the fact that the young of most species, even those which are by no means strictly insectivorous, require great quantities of animal food in the early weeks of existence, so that during the summer months—the flood time of insect life—birds are compelled to redouble their attacks on our insect foes to satisfy the wants of their clamorous young" (see page 671). "A nest with four young of the chipping sparrow was watched at different hours on four days. In the seven hours of observation 119 feedings were noted, or an average of 17 feedings per hour, or 4¼ feedings per hour to each nestling. This would give for a day of 14 hours at least 238 insects eaten by the brood" (see page 682).

Even our hawks and owls, with the exception of Cooper's hawk (see page 694) and one or two others, are desirable, and their presence around a garden or farm should be welcomed, because with their voracious appetites they keep down the numbers of mice and rats and other pests which may torment the country home. As many as 100 grasshoppers have been found in the stomach of a Swainson's hawk, representing a single meal; and in the retreat of a pair of barn owls have been found more than 3,000 skulls, 97 per cent of which were of mammals, the bulk consisting of field mice, house mice, and common rats (see page 670).

A lack of knowledge of the value of certain birds may prove disastrous and cause the destruction of valuable birds which cannot be replaced in years. Some years ago the legislature of the State of Pennsylvania offered a bounty on hawks and owls, which resulted in the killing of over 100,000 of these birds. As almost all of those killed were beneficial, it was calculated by Dr. C. Hart Merriam, then chief of the U. S. Biological Survey, that the State of Pennsylvania sustained a loss of nearly four million dollars in eighteen months. The legislature soon realized its mistake and abolished the bounty.

Quite apart from any question of sentiment, the preservation of our bird life is a matter of great national importance, and every effort should be made to assist our policemen of the air in keeping Nature's balance true.

The bird portraits in colors were printed by the Sackett & Wilhelms Lithograph Company of Brooklyn, N. Y.

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FIFTY COMMON BIRDS OF FARM AND ORCHARD

Prepared under the direction of Henry W. Henshaw, Chief of the Biological Survey, as Bulletin 513 of the U. S. Department of Agriculture, and reprinted in full in the NATIONAL GEOGRAPHIC MAGAZINE, *pages 669-697, by special permission of the Secretary of Agriculture.*

INTRODUCTION.

This bulletin is intended to serve the very practical purpose of enabling our farmers and their boys and girls to identify the birds that frequent the farm and orchard. The material prosperity of State and Nation depends largely on agriculture, and any agent that serves to increase the size of crops and insure their certainty is of direct interest and importance to the farmer. Birds constitute one of the most valuable of these agents, since they depend largely for their food on insects which are among the farmer's most dreaded foes.

Entomologists have estimated that insects yearly cause a loss of upwards of $700,000,000 to the agricultural interests of the United States. Were it not for our birds the loss would be very much greater, and indeed it is believed that without the aid of our feathered friends successful agriculture would be impossible. A knowledge of the birds that protect his crops is, therefore, as important to the farmer as a knowledge of the insect pests that destroy them. Such knowledge is the more important because the relation of birds to man's interests is extremely complex. Thus, while it may be said that most of our birds are useful, there are only a few of them that are always and everywhere useful and that never do harm. Insectivorous birds, for instance, destroy, along with a vast number of harmful insects, some parasitic and predatory kinds. These latter are among Nature's most effective agents for keeping destructive insects in check. To the extent, then, that birds destroy useful parasitic insects, they are harmful. But, taking the year round, the good they do by the destruction of insects injurious to man's interests far outweighs the little harm they do. It may be said, too, that of the birds usually classed as noxious there are very few that do not possess redeeming traits. Thus the crow is mischievous in spring and sorely taxes the farmer's patience and ingenuity to prevent him from pulling up the newly planted corn. Moreover, the crow destroys the eggs and young of useful insectivorous and game birds; but, on the other hand, he eats many insects, especially white grubs and cutworms, and destroys many meadow mice, so that in much (although not all) of the region he inhabits the crow must be considered to be more useful than harmful. Most of the hawks and owls even—birds that have received so bad a name that the farmer's boy and the sportsman are ever on the alert to kill them—are very useful because they destroy vast numbers of insects and harmful rodents.

Birds occupy a unique position among the enemies of insects, since their powers of flight enable them at short notice to gather at points where there are abnormal insect outbreaks. An unusual abundance of grasshoppers, for instance, in a given locality soon attracts the birds from a wide area, and as a rule their visits cease only when there are no grasshoppers left. So also a marked increase in the number of small rodents in a given neighborhood speedily attracts the attention of hawks and owls, which, by reason of their voracious appetites, soon produce a marked diminution of the swarming foe.

America is greatly favored in the number and character of its birds, which not only include some of the gems of the bird world, as the warblers and humming birds, but on the whole embrace few destructive species. Not only do many birds satisfy our esthetic sense through their beautiful plumage and their sweet voices, but they are marvelously adapted to their respective fields of activity. No other creatures are so well fitted to capture flying insects as swallows, swifts, and nighthawks. Among the avian ranks also are wrens, trim of body and agile of movement, that creep in and out of holes and crevices and explore rubbish heaps for hidden insects. The woodpecker, whose whole body exhibits wonderful adaptation of means to end, is provided with strong claws for holding firmly when at work, a chisel-like bill driven by powerful muscles to dig out insects, and a long extensible tongue to still further explore the hidden retreats of insects and drag forth the concealed larvæ, safe from other foes. The creepers, titmice, warblers, flycatchers, quails, doves, and other families have each their own special field of activity. However unlike they may be in appearance, structure, and habits, all are similar in one respect—they possess a never flagging appetite for insects and weed seeds.

One of the most useful groups of native birds is the sparrow family. While some of the tribe wear gay suits of many hues, most of the sparrows are clad in modest brown tints, and as they spend much of the time in grass and weeds are commonly overlooked. Unobtrusive as they are, they lay the farmer under a heavy debt of gratitude by their food habits, since their chosen fare consists largely of the seeds of weeds. Selecting a typical member of the group, the tree sparrow, for instance, one-fourth ounce of weed seed per day is a conservative estimate of the food of an adult. On this basis, in a large agricultural State like Iowa tree sparrows annually eat approximately 875 tons of weed seeds. Only the farmer, upon whose shoulders falls the heavy burden of freeing his land of noxious weeds, can realize what this vast consumption of weed seeds means in the saving and cost of labor. Some idea of the money value of this group of birds to the country may be gained from the statement that the total value of the farm products in the United States in 1910 reached the amazing sum of $8,926,000,000. If we estimate that the total consumption of weed seed by the combined members of the sparrow family resulted in a saving of only 1 per cent of the crops—not a violent assumption—the sum saved to farmers by these birds in 1910 was $89,260,000.

The current idea in relation to hawks and owls is erroneous. These birds are generally classed as thieves and robbers, whereas a large majority of them are the farmers' friends and spend the greater part of their long lives in pursuit of injurious insects and rodents. The hawks work by day, the owls chiefly by night, so that the useful activities of the two classes are continued practically throughout the 24 hours. As many as 100 grasshoppers have been found in the stomach of a Swainson's hawk, representing a single meal; and in the retreat of a pair of barn owls have been found more than 3,000 skulls, 97 per cent of which were of mammals, the bulk consisting of field mice, house mice, and common rats. Nearly half a bushel of the remains of pocket gophers—animals which are very destructive in certain parts of the United States—was found near a nest of this species. The notable increase of noxious rodents during the last few years in certain parts of the United States and the consequent damage to crops are due in no small part to the diminished number of birds of prey, which formerly destroyed them and aided in keeping down their numbers. A few hawks are injurious, and the bulk of the depredations on birds and chickens chargeable against hawks is committed by three species—the Cooper's hawk, the sharp-shinned hawk, and the goshawk. The farmer's boy should learn to know these daring robbers by sight, so as to kill them whenever possible.

From the foregoing it will at once appear that the practice of offering bounties indiscriminately for the heads of hawks and owls, as has been done by some States, is a serious mistake, the result being not only a waste of public funds but the destruction of valuable birds which can be replaced, if at all, only after the lapse of years.

As a rule birds do not live very long, but they live fast. They breathe rapidly and have a higher temperature and a more rapid circulation than other vertebrates. This is a fortunate circumstance, since to generate the requisite force to sustain their active bodies a large quantity of food is necessary, and as a matter of fact birds have to devote most of their waking hours to obtaining insects, seeds, berries, and other kinds of food. The activity of birds in the pursuit of insects is still further stimulated by the fact that the young of most species, even those which are by no means strictly insectivorous, require great quantities of animal food in the early weeks of existence, so that during the summer months—the flood time of insect life—birds are compelled to redouble their attacks on our insect foes to satisfy the wants of their clamorous young.

Field observations of the food habits of birds serve a useful purpose, but they are rarely accurate enough to be fully reliable. The presence of certain birds in a corn or wheat field or in an orchard is by no means proof, as is too often assumed, that they are devastating the grain or fruit. They may have been attracted by insects which, unknown to the farmer or orchardist, are fast ruining his crop. Hence it has been found necessary to examine the stomachs and crops of birds to ascertain definitely what and how much they eat. The Biological Survey has in this way examined upward of 50,000 birds, most of which have been obtained during the last 25 years from scientific collectors, for our birds are too useful to be sacrificed when it can possibly be avoided, even for the sake of obtaining data upon which to base legislation for their protection.

It is interesting to observe that hungry birds—and birds are hungry most of the time—are not content to fill their stomachs with insects or seeds, but after the stomach is stuffed until it will hold no more continue to eat till the crop or gullet also is crammed. It is often the case that when the stomach is opened and the contents piled up the pile is two or three times as large as the stomach was when filled. Birds may truly be said to have healthy appetites. To show the astonishing capacity of birds' stomachs and to reveal the extent to which man is indebted to birds for the destruction of noxious insects, the following facts are given as learned by stomach examinations made by assistants of the Biological Survey:

A tree swallow's stomach was found to contain 40 entire chinch bugs and fragments of many others, besides 10 other species of insects. A bank swallow in Texas devoured 68 cotton-boll weevils, one of the worst insect pests that ever invaded the United States; and 35 cliff swallows had taken an average of 18 boll weevils each. Two stomachs of pine siskins from Haywards, Cal., contained 1,900 black olive scales and 300 plant lice. A killdeer's stomach taken in November in Texas contained over 300 mosquito larvæ. A flicker's stomach held 28 white grubs. A nighthawk's stomach collected in Kentucky contained 34 May beetles, the adult form of white grubs. Another nighthawk from New York had eaten 24 clover-leaf weevils and 375 ants. Still another nighthawk had eaten 340 grasshoppers, 52 bugs, 3 beetles, 2 wasps, and a spider. A boat-tailed grackle from Texas had eaten at one meal about 100 cotton bollworms, besides a few other insects. A ring-necked pheasant's crop from Washington contained 8,000 seeds of chickweed and a dandelion head. More than 72,000 seeds have been found in a single duck stomach taken in Louisiana in February.

A knowledge of his bird friends and enemies, therefore, is doubly important to the farmer and orchardist in order that he may protect the kinds that earn protection by their services and may drive away or destroy the others. At the present time many kinds of useful birds need direct intervention in their behalf as never before. The encroachments of civilization on timbered tracts and the methods of modern intensive cultivation by destroying or restricting breeding grounds of birds tend to diminish their ranks. The number of insect pests, on the other hand, is all the time increasing by leaps and bounds through importations from abroad and by migration from adjoining territories. Every effort, therefore, should be made to augment the numbers of our useful birds by protecting them from their enemies, by providing nesting facilities, and by furnishing them food in times of stress, especially in winter.

Important in this connection is the planting near the house and even in out-of-the-way places on the farm of various berry-bearing shrubs, many of which are ornamental, which will supply food when snow is on the ground. Other species which are not berry eaters, like the woodpeckers, nuthatches, creepers, and chickadees, can be made winter residents of many farms, even in the North, by putting out at convenient places a supply of suet, of which they and many other birds are very fond, even in summer. Hedges and thickets about the farm are important to furnish nesting sites and shelter both from the elements and from the numerous enemies of birds.

Few are aware of the difficulty often experienced by birds in obtaining water for drinking and bathing, and a constant supply of water near the farmhouse will materially aid in attracting birds to the neighborhood and in keeping them there, at least till the time of migration. Shallow trays of wood or metal admirably serve the purpose, especially as birds delight to bathe in them.

Considerable success has been met with in Germany and elsewhere in Europe by supplying artificial nest boxes for birds, and the same method of increasing the number of birds and attracting them to farms and orchards where their services are most needed should be extensively employed in this country. The experiment can the more easily be tried since several firms in the United States are now prepared to make and deliver boxes specially designed for martins, swallows, bluebirds, wrens, woodpeckers, and other species. The average farmer's boy, however, if provided with a few tools, is quite equal to the task of making acceptable boxes for the commoner species, which are far from fastidious as to the appearance of the box intended for their occupancy.

One of the worst foes of our native birds is the house cat, and probably none of our native wild animals destroys as many birds on the farm, particularly fledglings, as cats. The household pet is by no means blameless in this respect, for the bird-hunting instinct is strong even in the well-fed tabby; but much of the loss of our feathered life is attributable to the half-starved stray, which in summer is as much at home in the groves and fields as the birds themselves. Forced to forage for their own livelihood, these animals, which are almost as wild as the ancestral wildcat, inflict an appalling loss on our feathered allies and even on the smaller game birds like the woodcock and bobwhite. If cats are to find place in the farmer's household, every effort should be made by carefully feeding and watching them to insure the safety of the birds. The cat without a home should be mercifully put out of the way.

In the present bulletin 50 of our commoner birds are discussed, including some that are destructive. They inhabit various parts of the country, and it is for the interest of the farmers of the respective localities to be familiar with them. A colored illustration of each species is given so as to enable the reader to identify the bird at a glance and to permit the descriptive text, at best an unsatisfactory method of identification, to be cut down or altogether dispensed with. The birds were drawn from nature by the well-known bird artist, Louis Agassiz Fuertes. The accounts of the birds' habits are necessarily brief, but they are believed to be sufficient to acquaint the reader with the most prominent characteristics of the several species, at least from the standpoint of their relation to man.

BLUEBIRD (Sialia sialis).

Length,* about 6½ inches.

Range: Breeds in the United States (west to Arizona, Colorado, Wyoming, and Montana), southern Canada, Mexico, and Guatemala; winters in the southern half of the eastern United States and south to Guatemala.

Habits and economic status: The bluebird is one of the most familiar tenants of the farm and dooryard. Everywhere it is hailed as the harbinger of spring, and wherever it chooses to reside it is sure of a warm welcome. This bird, like the robin, phoebe, house wren, and some swallows, is very domestic in its habits. Its favorite nesting sites are crannies in the farm buildings or boxes made for its use or natural cavities in old apple trees. For rent the bird pays amply by destroying insects, and it takes no toll from the farm crop. The bluebird's diet consists of 68 per cent of insects to 32 per cent of vegetable matter. The largest items of insect food are grasshoppers first and beetles next, while caterpillars stand third. All of these are harmful except a few of the beetles. The vegetable food consists chiefly of fruit pulp, only an insignificant portion of which is of cultivated varieties. Among wild fruits elderberries are the favorite. From the above it will be seen that the bluebird does no essential harm, but on the contrary eats many harmful and annoying insects. (See Farmers' Bul. 54, pp. 46–48.)

ROBIN (Planesticus migratorius).

Length, 10 inches.

Range: Breeds in the United States (except the Gulf States), Canada, Alaska, and Mexico; winters in most of the United States and south to Guatemala.

Habits and economic status: In the North and some parts of the West the robin is among the most cherished of our native birds. Should it ever become rare where now common, its joyous summer song and familiar presence will be sadly missed in many a homestead. The robin is an omnivorous feeder, and its food includes many orders of insects, with no very pronounced preference for any. It is very fond of earthworms, but its real economic status is determined by the vegetable food, which amounts to about 58 per cent of all. The principal item is fruit, which forms more than 51 per cent of the total food. The fact that in the examination of over 1,200 stomachs the percentage of wild fruit was found to be 5 times that of the cultivated varieties suggests that berry-bearing shrubs, if planted near the orchard, will serve to protect more valuable fruits. In California in certain years it has been possible to save the olive crop from hungry robins only by the most strenuous exertions and considerable expense. The bird's general usefulness is such, however, that all reasonable means of protecting orchard fruit should be tried before killing the birds. (See Farmers' Bul. 54, pp. 44–46.)

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* Measured from tip of bill to tip of tail.

RUSSET-BACKED THRUSH (Hylocichla ustulata).

Length, 7¼ inches. Among thrushes having the top of head and tail nearly the same color as the back, this one is distinguished by its tawny eye-ring and cheeks. The Pacific coast subspecies is russet brown above, while the other subspecies is the olive-backed thrush. The remarks below apply to the species as a whole.

Range: Breeds in the forested parts of Alaska and Canada and south to California, Colorado, Michigan, New York, West Virginia (mountains), and Maine; winters from Mexico to South America.

Habits and economic status: This is one of a small group of thrushes the members of which are by many ranked first among American songbirds. The several members resemble one another in size, plumage, and habits. While this thrush is very fond of fruit, its partiality for the neighborhood of streams keeps it from frequenting orchards far from water. It is most troublesome during the cherry season, when the young are in the nest. From this it might be inferred that the young are fed on fruit, but such is not the case. The adults eat fruit, but the nestlings, as usual, are fed mostly upon insects. Beetles constitute the largest item of animal food, and ants come next. Many caterpillars also are eaten. The great bulk of vegetable food consists of fruit, of which two-fifths is of cultivated varieties. Where these birds live in or near gardens or orchards, they may do considerable damage, but they are too valuable as insect destroyers to be killed if the fruit can be protected in any other way. (See Biol. Surv. Bul. 30, pp. 86–92.)

RUBY-CROWNED KINGLET (Regulus calendula).

Length, about 4¼ inches. Olive green above, soiled whitish below, concealed feathers on head (crest) bright red.

Range: Breeds in southern Canada, southern Alaska, and the higher mountains of the western United States; winters in much of the United States and south to Guatemala.

Habits and economic status: In habits and haunts this tiny sprite resembles a chickadee. It is an active, nervous little creature, flitting hither and yon in search of food, and in spring stopping only long enough to utter its beautiful song, surprisingly loud for the size of the musician. Three-fourths of its food consists of wasps, bugs, and flies. Beetles are the only other item of importance (12 per cent). The bugs eaten by the kinglet are mostly small, but, happily, they are the most harmful kinds. Treehoppers, leafhoppers, and jumping plant lice are pests and often do great harm to trees and smaller plants, while plant lice and scale insects are the worst scourges of the fruit grower—in fact, the prevalence of the latter has almost risen to the magnitude of a national peril. It is these small and seemingly insignificant birds that most successfully attack and hold in check these insidious foes of horticulture. The vegetable food consists of seeds of poison ivy, or poison oak, a few weed seeds, and a few small fruits, mostly elderberries. (See Biol. Surv. Bul. 30, pp. 81–84.)

CHICKADEE (Penthestes atricapillus).

Length, about 5¼ inches.

Range: Resident in the United States (except the southern half east of the plains), Canada, and Alaska.

Habits and economic status: Because of its delightful notes, its confiding ways, and its fearlessness, the chickadee is one of our best-known birds. It responds to encouragement, and by hanging within its reach a constant supply of suet the chickadee can be made a regular visitor to the garden and orchard. Though insignificant in size, titmice are far from being so from the economic standpoint, owing to their numbers and activity. While one locality is being scrutinized for food by a larger bird, 10 are being searched by the smaller species. The chickadee's food is made up of insects and vegetable matter in the proportion of 7 of the former to 3 of the latter. Moths and caterpillars are favorites and form about one-third of the whole. Beetles, ants, wasps, bugs, flies, grasshoppers, and spiders make up the rest. The vegetable food is composed of seeds, largely those of pines, with a few of the poison ivy and some weeds. There are few more useful birds than the chickadees. (See Farmers' Bul. 54, pp. 43–44.)

WHITE-BREASTED NUTHATCH (Sitta carolinensis).

Length, 6 inches. White below, above gray, with a black head.

Range: Resident in the United States, southern Canada, and Mexico.

Habits and economic status: This bird might readily be mistaken by a careless observer for a small woodpecker, but its note, an oft-repeated *yank*, is very unwoodpecker-like, and, unlike either woodpeckers or creepers, it climbs downward as easily as upward and seems to set the laws of gravity at defiance. The name was suggested by the habit of wedging nuts, especially beechnuts, in the crevices of bark so as to break them open by blows from the sharp, strong bill. The nuthatch gets its living from the trunks and branches of trees, over which it creeps from daylight to dark. Insects and spiders constitute a little more than 50 per cent of its food. The largest items of these are beetles, moths, and caterpillars, with ants and wasps. The animal food is all in the bird's favor except a few ladybird beetles. More than half of the vegetable food consists of mast, i. e., acorns and other nuts or large seeds. One-tenth of the food is grain, mostly waste corn. The nuthatch does no injury, so far as known, and much good.

BROWN CREEPER (Certhia familiaris americana and other subspecies).

Length, 5¼ inches.

Range: Breeds from Nebraska, Indiana, North Carolina (mountains), and Massachusetts north to southern Canada, also in the mountains of the western United States, north to Alaska, south to Nicaragua; winters over most of its range.

Habits and economic status: Rarely indeed is the creeper seen at rest. It appears to spend its life in an incessant scramble over the trunks and branches of trees, from which it gets all its food. It is protectively colored so as to be practically invisible to its enemies and, though delicately built, possesses amazingly strong claws and feet. Its tiny eyes are sharp enough to detect insects so small that most other species pass them by, and altogether the creeper fills a unique place in the ranks of our insect destroyers. The food consists of minute insects and insects' eggs, also cocoons of tineid moths, small wasps, ants, and bugs, especially scales and plant lice, with some small caterpillars. As the creeper remains in the United States throughout the year, it naturally secures hibernating insects and insects' eggs, as well as spiders and spiders' eggs, that are missed by the summer birds. On its bill of fare we find no product of husbandry nor any useful insects.

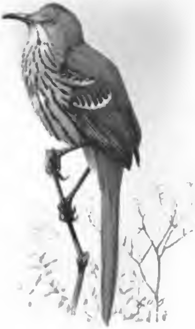
HOUSE WREN (Troglodytes aëdon).

Length, 4¾ inches. The only one of our wrens with wholly whitish underparts that lacks a light line over the eye.

Range: Breeds throughout the United States (except the South Atlantic and Gulf States) and southern Canada; winters in the southern United States and Mexico.

Habits and economic status: The rich, bubbling song of the familiar little house wren is one of the sweetest associations connected with country and suburban life. Its tiny body, long bill, sharp eyes, and strong feet peculiarly adapt it for creeping into all sorts of nooks and crannies where lurk the insects it feeds on. A cavity in a fence post, a hole in a tree, or a box will be welcomed alike by this busybody as a nesting site; but since the advent of the quarrelsome English sparrow such domiciles are at a premium and the wren's eggs and family are safe only in cavities having entrances too small to admit the sparrow. Hence it behooves the farmer's boy to provide boxes the entrances to which are about an inch in diameter, nailing these under gables of barns and outhouses or in orchard trees. In this way the numbers of this useful bird can be increased, greatly to the advantage of the farmer. Grasshoppers, beetles, caterpillars, bugs, and spiders are the principal elements of its food. Cutworms, weevils, ticks, and plant lice are among the injurious forms eaten. The nestlings of house wrens consume great quantities of insects. (See Yearbook U. S. Dept. Agric. 1895, pp. 416–418, and Biol. Survey Bul. 30, pp. 60–62.)

BROWN THRASHER (Toxostoma rufum).



Length, about 11 inches. Brownish red above, heavily streaked with black below.

Range: Breeds from the Gulf States to southern Canada and west to Colorado, Wyoming, and Montana; winters in the southern half of the eastern United States.

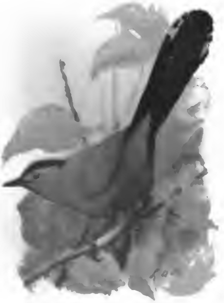
Habits and economic status: The brown thrasher is more retiring than either the mocking bird or catbird, but like them is a splendid singer. Not infrequently, indeed, its song is taken for that of its more famed cousin, the mocking bird. It is partial to thickets and gets much of its food from the ground. Its search for this is usually accompanied by much scratching and scattering of leaves; whence its common name. Its call note is a sharp sound like the smacking of lips, which is useful in identifying this long-tailed, thicket-haunting bird, which does not much relish close scrutiny. The brown thrasher is not so fond of fruit as the catbird and mocker, but devours a much larger percentage of animal food. Beetles form one-half of the animal food, grasshoppers and crickets one-fifth, caterpillars, including cutworms, somewhat less than one-fifth, and bugs, spiders, and millipeds comprise most of the remainder. The brown thrasher feeds on such coleopterous pests as wireworms, May beetles, rice weevils, rose beetles, and figeaters. By its destruction of these and other insects, which constitute more than 60 per cent of its food, the thrasher much more than compensates for that portion (about one-tenth) of its diet derived from cultivated crops. (See Yearbook U. S. Dept. Agric. 1895, pp. 411–415.)

CATBIRD (Dumetella carolinensis).

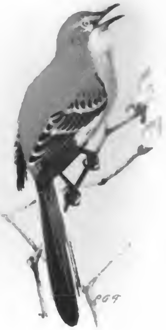
Length, about 9 inches. The slaty gray plumage and black cap and tail are distinctive.

Range: Breeds throughout the United States west to New Mexico, Utah, Oregon, and Washington, and in southern Canada; winters from the Gulf States to Panama.

Habits and economic status: In many localities the catbird is one of the commonest birds. Tangled growths are its favorite nesting places and retreats, but berry patches and ornamental shrubbery are not disdained. Hence the bird is a familiar dooryard visitor. The bird has a fine song, unfortunately marred by occasional cat calls. With habits similar to those of the mocking bird and a song almost as varied, the catbird has never secured a similar place in popular favor. Half of its food consists of fruit, and the cultivated crops most often injured are cherries, strawberries, raspberries, and blackberries. Beetles, ants, crickets, and grasshoppers are the most important element of its animal food. The bird is known to attack a few pests, as cutworms, leaf beetles, clover-root curculio, and the periodical cicada, but the good it does in this way probably does not pay for the fruit it steals. The extent to which it should be protected may perhaps be left to the individual cultivator; that is, it should be made lawful to destroy catbirds that are doing manifest damage to crops. (See Yearbook U. S. Dept. Agric. 1895, pp. 406–411.)



MOCKING BIRD (Mimus polyglottos).



Length, 10 inches. Most easily distinguished from the similarly colored loggerhead shrike (see p. 679) by the absence of a conspicuous black stripe through the eye.

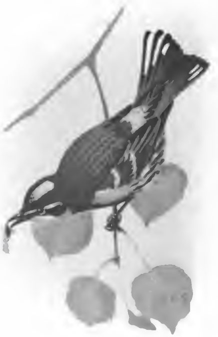
Range: Resident from southern Mexico north to California, Wyoming, Iowa, Ohio, and Maryland; casual farther north.

Habits and economic status: Because of its incomparable medleys and imitative powers, the mocking bird is the most renowned singer of the Western Hemisphere. Even in confinement it is a masterly performer, and formerly thousands were trapped and sold for cage birds, but this reprehensible practice has been largely stopped by protective laws. It is not surprising, therefore, that the mocking bird should receive protection principally because of its ability as a songster and its preference for the vicinity of dwellings. Its place in the affections of the South is similar to that occupied by the robin in the North. It is well that this is true, for the bird appears not to earn protection from a strictly economic standpoint. About half of its diet consists of fruit, and many cultivated varieties are attacked, such as oranges, grapes, figs, strawberries, blackberries, and raspberries. Somewhat less than a fourth of the food is animal matter, and grasshoppers are the largest single element. The bird is fond of cotton worms, and is known to feed also on the chinch bug, rice weevil, and bollworm. It is unfortunate that it does not feed on injurious insects to an extent sufficient to offset its depredations on fruit. (See Yearbook U. S. Dept. Agric. 1895, pp. 415–416, and Biol. Survey Bul. 30, pp. 52–56.)

MYRTLE WARBLER (Dendroica coronata).

Length, 5½ inches. The similarly colored Audubon's warbler has a yellow throat instead of a white one.

Range: Breeds throughout most of the forested area of Canada and south to Minnesota, Michigan, New York, and Massachusetts; winters in the southern two-thirds of the United States and south to Panama.



Habits and economic status: This member of our beautiful wood warbler family, a family peculiar to America, has the characteristic voice, coloration, and habits of its kind. Trim of form and graceful of motion, when seeking food it combines the methods of the wrens, creepers, and flycatchers. It breeds only in the northern parts of the eastern United States, but in migration it occurs in every patch of woodland and is so numerous that it is familiar to every observer. Its place is taken in the West by Audubon's warbler. More than three-fourths of the food of the myrtle warbler consists of insects, practically all of them harmful. It is made up of small beetles, including some weevils, with many ants and wasps. This bird is so small and nimble that it successfully attacks insects too minute to be prey for larger birds. Scales and plant lice form a very considerable part of its diet. Flies are the largest item of food; in fact, only a few flycatchers and swallows eat as many flies as this bird. The vegetable food (22 per cent) is made up of fruit and the seeds of poison oak or ivy, also the seeds of pine and of the bayberry.

LOGGERHEAD SHRIKE (Lanius ludovicianus).

Length, about 9 inches. A gray, black, and white bird, distinguished from the somewhat similarly colored mocking bird by the black stripe on side of head.

Range: Breeds throughout the United States, Mexico, and southern Canada; winters in the southern half of the United States and in Mexico.

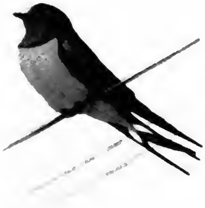
Habits and economic status: The loggerhead shrike, or southern butcher bird, is common throughout its range and is sometimes called "French mocking bird" from a superficial resemblance and not from its notes, which are harsh and unmusical. The shrike is naturally an insectivorous bird which has extended its bill of fare to include small mammals, birds, and reptiles. Its hooked beak is well adapted to tearing its prey, while to make amends for the lack of talons it has hit upon the plan of forcing its victim, if too large to swallow, into the fork of a bush or tree, where it can tear it asunder. Insects, especially grasshoppers, constitute the larger part of its food, though beetles, moths, caterpillars, ants, wasps, and a few spiders also are taken. While the butcher bird occasionally catches small birds, its principal vertebrate food is small mammals, as field mice, shrews, and moles, and when possible it obtains lizards. It habitually impales its surplus prey on a thorn, sharp twig, or barb of a wire fence. (See Biol. Survey Bul. 9, pp. 20–24, and Bul. 30, pp. 33–38.)

BARN SWALLOW (Hirundo erythrogastra).

Length, about 7 inches. Distinguished among our swallows by deeply forked tail.

Range: Breeds throughout the United States (except the South Atlantic and Gulf States) and most of Canada; winters in South America.

Habits and economic status: This is one of the most familiar birds of the farm and one of the greatest insect destroyers. From daylight to dark on tireless wings it seeks its prey, and the insects destroyed are countless. Its favorite nesting site is a barn rafter, upon which it sticks its mud basket. Most modern barns are so tightly constructed that swallows can not gain entrance, and in New England and some other parts of the country barn swallows are much less numerous than formerly. Farmers can easily provide for the entrance and exit of the birds and so add materially to their numbers. It may be well to add that the parasites that sometimes infest the nests of swallows are not the ones the careful housewife dreads, and no fear need be felt of the infestation spreading to the houses. Insects taken on the wing constitute the almost exclusive diet of the barn swallow. More than one-third of the whole consists of flies, including unfortunately some useful parasitic species. Beetles stand next in order and consist of a few weevils and many of the small dung beetles of the May beetle family that swarm over the pastures in the late afternoon. Ants amount to more than one-fifth of the whole food, while wasps and bees are well represented.



PURPLE MARTIN (Progne subis).

Length, about 8 inches.

Range: Breeds throughout the United States and southern Canada, south to central Mexico; winters in South America.

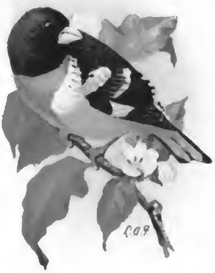
Habits and economic status: This is the largest as it is one of the most beautiful of the swallow tribe. It formerly built its nests in cavities of trees, as it still does in wild districts, but learning that man was a friend it soon adopted domestic habits. Its presence about the farm can often be secured by erecting houses suitable for nesting sites and protecting them from usurpation by the English sparrow, and every effort should be made to increase the number of colonies of this very useful bird. The boxes should be at a reasonable height, say 15 feet from the ground, and made inaccessible to cats. A colony of these birds on a farm makes great inroads upon the insect population, as the birds not only themselves feed upon insects but rear their young upon the same diet. Fifty years ago in New England it was not uncommon to see colonies of 50 pairs of martins, but most of them have now vanished for no apparent reason except that the martin houses have decayed and have not been renewed. More than three-fourths of this bird's food consists of wasps, bugs, and beetles, their importance being in the order given. The beetles include several species of harmful weevils, as the clover-leaf weevils and the nut weevils. Besides these are many crane flies, moths, May flies, and dragonflies.

BLACK-HEADED GROSBEAK (Zamelodia melanocephala).

Length, about 8¼ inches.

Range: Breeds from the Pacific coast to Nebraska and the Dakotas, and from southern Canada to southern Mexico; winters in Mexico.

Habits and economic status: The black-headed grosbeak takes the place in the West of the rosebreast in the East, and like it is a fine songster. Like it also the blackhead readily resorts to orchards and gardens and is common in agricultural districts. The bird has a very powerful bill and easily crushes or cuts into the firmest fruit. It feeds upon cherries, apricots, and other fruits, and also does some damage to green peas and beans, but it is so active a foe of certain horticultural pests that we can afford to overlook its faults. Several kinds of scale insects are freely eaten, and one, the black olive scale, constitutes a fifth of the total food. In May many cankerworms and codling moths are consumed, and almost a sixth of the bird's seasonal food consists of flower beetles, which do incalculable damage to cultivated flowers and to ripe fruit. For each quart of fruit consumed by the black-headed grosbeak it destroys in actual bulk more than 1½ quarts of black olive scales and 1 quart of flower beetles, besides a generous quantity of codling-moth pupæ and cankerworms. It is obvious that such work as this pays many times over for the fruit destroyed. (See Biol. Survey Bul. 32, pp. 60–77.)



ROSE-BREASTED GROSBEAK (Zamelodia ludoviciana).

Length, 8 inches.

Range: Breeds from Kansas, Ohio, Georgia (mountains), and New Jersey, north to southern Canada; winters from Mexico to South America.

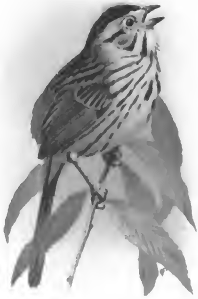
Habits and economic status: This beautiful grosbeak is noted for its clear, melodious notes, which are poured forth in generous measure. The rosebreast sings even at midday during summer, when the intense heat has silenced almost every other songster. Its beautiful plumage and sweet song are not its sole claim on our favor, for few birds are more beneficial to agriculture. The rosebreast eats some green peas and does some damage to fruit. But this mischief is much more than balanced by the destruction of insect pests. The bird is so fond of the Colorado potato beetle that it has earned the name of "potato-bug bird," and no less than a tenth of the total food of the rosebreasts examined consists of potato beetles—evidence that the bird is one of the most important enemies of the pest. It vigorously attacks cucumber beetles and many of the scale insects. It proved an active enemy of the Rocky Mountain locust during that insect's ruinous invasions, and among the other pests it consumes are the spring and fall cankerworms, orchard and forest tent caterpillars, tussock, gipsy, and brown-tail moths, plum curculio, army worm, and chinch bug. In fact, not one of our birds has a better record. (See Biol. Survey Bul. 32, pp. 33–59.)

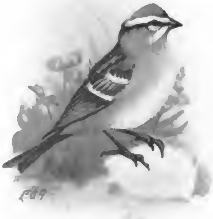
SONG SPARROW (Melospiza melodia).

Length, about 6¼ inches. The heavily spotted breast with heavy central blotch is characteristic.

Range: Breeds in the United States (except the South Atlantic and Gulf States), southern Canada, southern Alaska, and Mexico; winters in Alaska and most of the United States southward.

Habits and economic status: Like the familiar little "chippy," the song sparrow is one of our most domestic species, and builds its nest in hedges or in garden shrubbery close to houses, whenever it is reasonably safe from the house cat, which, however, takes heavy toll of the nestlings. It is a true harbinger of spring, and its delightful little song is trilled forth from the top of some green shrub in early March and April, before most of our other songsters have thought of leaving the sunny south. Song sparrows vary much in habits, as well as in size and coloration. Some forms live along streams bordered by deserts, others in swamps among bulrushes and tules, others in timbered regions, others on rocky barren hillsides, and still others in rich, fertile valleys. With such a variety of habitat, the food of the species naturally varies considerably. About three-fourths of its diet consists of the seeds of noxious weeds and one-fourth of insects. Of these, beetles, especially weevils, constitute the major portion. Ants, wasps, bugs (including the black olive scale), and caterpillars are also eaten. Grasshoppers are taken by the eastern birds, but not by the western ones. (See Biol. Survey Bul. 15, pp. 82–86.)





CHIPPING SPARROW (Spizella passerina).

Length, about 5¼ inches. Distinguished by the chestnut crown, black line through eye, and black bill.

Range: Breeds throughout the United States, south to Nicaragua, and north to southern Canada; winters in the southern United States and southward.

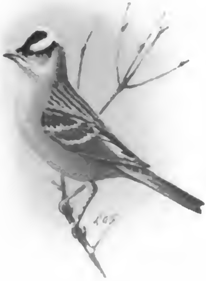
Habits and economic status: The chipping sparrow is very friendly and domestic, and often builds its nest in gardens and orchards or in the shrubbery close to dwellings. Its gentle and confiding ways endear it to all bird lovers. It is one of the most insectivorous of all the sparrows. Its diet consists of about 42 per cent of insects and spiders and 58 per cent of vegetable matter. The animal food consists largely of caterpillars, of which it feeds a great many to its young. Besides these, it eats beetles, including many weevils, of which one stomach contained 30. It also eats ants, wasps, and bugs. Among the latter are plant lice and black olive scales. The vegetable food is practically all weed seed. A nest with 4 young of this species was watched at different hours on 4 days. In the 7 hours of observation 119 feedings were noted, or an average of 17 feedings per hour, or 4¼ feedings per hour to each nestling. This would give for a day of 14 hours at least 238 insects eaten by the brood. (See Biol. Survey Bul. 15, pp. 76–78.)

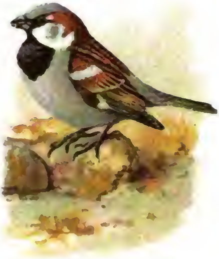
WHITE-CROWNED SPARROW (Zonotrichia leucophrys).

Length, 7 inches. The only similar sparrow, the white-throat, has a yellow spot in front of eye.

Range: Breeds in Canada, the mountains of New Mexico, Colorado, Wyoming, and Montana, and thence to the Pacific coast; winters in the southern half of the United States and in northern Mexico.

Habits and economic status: This beautiful sparrow is much more numerous in the western than in the eastern States, where, indeed, it is rather rare. In the East it is shy and retiring, but it is much bolder and more conspicuous in the far West and there often frequents gardens and parks. Like most of its family it is a seed eater by preference, and insects comprise very little more than 7 per cent of its diet. Caterpillars are the largest item, with some beetles, a few ants and wasps, and some bugs, among which are black olive scales. The great bulk of the food, however, consists of weed seeds, which amount to 74 per cent of the whole. In California this bird is accused of eating the buds and blossoms of fruit trees, but buds or blossoms were found in only 30 out of 516 stomachs, and probably it is only under exceptional circumstances that it does any damage in this way. Evidently neither the farmer nor the fruit grower has much to fear from the white-crowned sparrow. The little fruit it eats is mostly wild, and the grain eaten is waste or volunteer. (See Biol. Survey Bul. 34, pp. 75–77.)





ENGLISH SPARROW (Passer domesticus).

Length, about 6¼ inches. Its incessant chattering, quarrelsome disposition, and abundance and familiarity about human habitations distinguish it from our native sparrows.

Range: Resident throughout the United States and southern Canada.

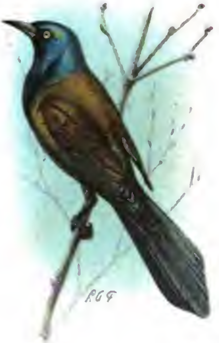
Habits and economic status: Almost universally condemned since its introduction into the United States, the English sparrow has not only held its own, but has ever increased in numbers and extended its range in spite of all opposition. Its habit of driving out or even killing more beneficial species and the defiling of buildings by its droppings and by its own unsightly structures, are serious objections to this sparrow. Moreover, in rural districts, it is destructive to grain, fruit, peas, beans, and other vegetables. On the other hand, the bird feeds to some extent on a large number of insect pests, and this fact points to the need of a new investigation of the present economic status of the species, especially as it promises to be of service in holding in check the newly introduced alfalfa weevil, which threatens the alfalfa industry in Utah and neighboring States. In cities most of the food of the English sparrow is waste material secured from the streets.

CROW BLACKBIRD (Quiscalus quiscula).

Length, 12 inches. Shorter by at least 3 inches than the other grackles with trough-shaped tails. Black, with purplish, bluish, and bronze reflections.

Range: Breeds throughout the United States west to Texas, Colorado, and Montana, and in southern Canada; winters in the southern half of the breeding range.

Habits and economic status: This blackbird is a beautiful species, and is well known from its habit of congregating in city parks and nesting there year after year. Like other species which habitually assemble in great flocks, it is capable of inflicting much damage on any crop it attacks, and where it is harmful a judicious reduction of numbers is probably sound policy. It shares with the crow and blue jay the evil habit of pillaging the nests of small birds of eggs and young. Nevertheless it does much good by destroying insect pests, especially white grubs, weevils, grasshoppers, and caterpillars. Among the caterpillars are army worms and other cutworms. When blackbirds gather in large flocks, as in the Mississippi Valley, they may greatly damage grain, either when first sown or when in the milk. In winter they subsist mostly on weed seed and waste grain. (See Biol. Surv. Bul. 13, pp. 53–70.)



BREWER'S BLACKBIRD (Euphagus cyanocephalus).

Length, 10 inches. Its glossy purplish head distinguishes it from other blackbirds that do not show in flight a trough-shaped tail.

Range: Breeds in the West, east to Texas, Kansas, and Minnesota, and north to southern Canada; winters over most of the United States breeding range, south to Guatemala.

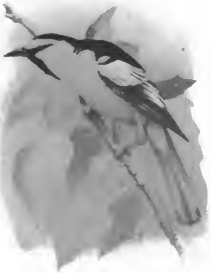
Habits and economic status: Very numerous in the West and in fall gathers in immense flocks, especially about barnyards and corrals. During the cherry season in California Brewer's blackbird is much in the orchards. In one case they were seen to eat freely of cherries, but when a neighboring fruit raiser began to plow his orchard almost every blackbird in the vicinity was upon the newly opened ground and close at the plowman's heels in its eagerness to get the insects exposed by the plow. Caterpillars and pupæ form the largest item of animal food (about 12 per cent). Many of these are cutworms, and cotton bollworms or corn earworms were found in 10 stomachs and codling-moth pupæ in 11. Beetles constitute over 11 per cent of the food. The vegetable food is practically contained in three items—grain, fruit, and weed seeds. Grain, mostly oats, amounts to 54 per cent; fruit, largely cherries, 4 per cent; and weed seeds, not quite 9 per cent. The grain is probably mostly wild, volunteer, or waste, so that the bird does most damage by eating fruit. (See Biol. Surv. Bul. 34, pp. 59-65.)

BULLOCK'S ORIOLE (Icterus bullocki).

Length, about 8 inches. Our only oriole with top of head and throat black and cheeks orange.

Range: Breeds from South Dakota, Nebraska, and Kansas to the Pacific Ocean and from southern Canada to northern Mexico; winters in Mexico.

Habits and economic status: In the West this bird takes the place occupied in the East by the Baltimore oriole. In food, nesting habits, and song the birds are similar. Both are migratory and remain on their summer range only some five or six months. They take kindly to orchards, gardens, and the vicinity of farm buildings and often live in villages and city parks. Their diet is largely made up of insects that infest orchards and gardens. When fruit trees are in bloom they are constantly busy among the blossoms and save many of them from destruction. In the food of Bullock's oriole beetles amount to 35 per cent and nearly all are harmful. Many of these are weevils, some of which live upon acorns and other nuts. Ants and wasps amount to 15 per cent of the diet. The black olive scale was found in 45 of the 162 stomachs examined. Caterpillars, with a few moths and pupæ, are the largest item of food and amount to over 41 per cent. Among these were codling-moth larvæ. The vegetable food is practically all fruit (19 per cent) and in cherry season consists largely of that fruit. Eating small fruits is the bird's worst trait, but it will do harm in this way only when very numerous. (See Biol. Surv. Bul. 34, pp. 68-71.)



MEADOWLARKS (Sturnella magna and Sturnella neglecta).

Length, about 10¾ inches.

Range: Breed generally in the United States, southern Canada, and Mexico to Costa Rica; winter from the Ohio and Potomac Valleys and British Columbia southward.

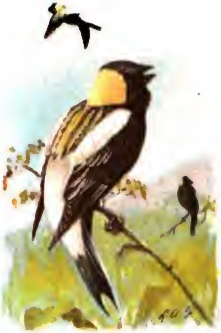
Habits and economic status: Our two meadowlarks, though differing much in song, resemble each other closely in plumage and habits. Grassy plains and uplands covered with a thick growth of grass or weeds, with near-by water, furnish the conditions best suited to the meadowlark's taste. The song of the western bird is loud, clear, and melodious. That of its eastern relative is feebler and loses much by comparison. In many localities the meadowlark is classed and shot as a game bird. From the farmer's standpoint this is a mistake, since its value as an insect eater is far greater than as an object of pursuit by the sportsman. Both the boll weevil, the foe of the cotton grower, and the alfalfa weevil are among the beetles it habitually eats. Twenty-five per cent of the diet of this bird is beetles, half of which are predaceous ground beetles, accounted useful insects, and one-fifth are destructive weevils. Caterpillars form 11 per cent of the food and are eaten in every month in the year. Among these are many cutworms and the well-known army worm. Grasshoppers are favorite food and are eaten in every month and almost every day. The vegetable food (24 per cent of the whole) consists of grain and weed seeds. (See Yearbook U. S. Dept. Agr. 1895, pp. 420–426.)

RED-WINGED BLACKBIRD (Agelaius phœniceus).

Length, about 9½ inches.

Range: Breeds in Mexico and North America south of the Barren Grounds; winters in southern half of United States and south to Costa Rica.

Habits and economic status: The prairies of the upper Mississippi Valley, with their numerous sloughs and ponds, furnish ideal nesting places for redwings, and consequently this region has become the great breeding ground for the species. These prairies pour forth the vast flocks that play havoc with grainfields. East of the Appalachian Range, marshes on the shores of lakes, rivers, and estuaries are the only available breeding sites and, as these are comparatively few and small, the species is much less abundant than in the West. Redwings are eminently gregarious, living in flocks and breeding in communities. The food of the redwing consists of 27 per cent animal matter and 73 per cent vegetable. Insects constitute practically one-fourth of the food. Beetles (largely weevils, a most harmful group) amount to 10 per cent. Grasshoppers are eaten in every month and amount to about 5 per cent. Caterpillars (among them the injurious army worm) are eaten at all seasons and aggregate 6 per cent. Ants, wasps, bugs, flies, dragonflies, and spiders also are eaten. The vegetable food consists of seeds, including grain, of which oats is the favorite, and some small fruits. When in large flocks this bird is capable of doing great harm to grain. (See Biol. Survey Bul. 13, pp. 33–34.)



BOBOLINK (Dolichonyx oryzivorus).

Length, about 7 inches.

Range: Breeds from Ohio northeast to Nova Scotia, north to Manitoba, and northwest to British Columbia; winters in South America.

Habits and economic status: When American writers awoke to the beauty and attractiveness of our native birds, among the first to be enshrined in song and story was the bobolink. Few species show such striking contrasts in the color of the sexes, and few have songs more unique and whimsical. In its northern home the bird is loved for its beauty and its rich melody; in the South it earns deserved hatred by its destructiveness. Bobolinks reach the southeastern coast of the United States the last half of April just as rice is sprouting and at once begin to pull up and devour the sprouting kernels. Soon they move on to their northern breeding grounds, where they feed upon insects, weed seeds, and a little grain. When the young are well on the wing, they gather in flocks with the parent birds and gradually move southward, being then generally known as reed birds. They reach the rice fields of the Carolinas about August 20, when the rice is in the milk. Then until the birds depart for South America planters and birds fight for the crop, and in spite of constant watchfulness and innumerable devices for scaring the birds a loss of 10 per cent of the rice is the usual result. (See Biol. Survey Bul. 13, pp. 12–22.)

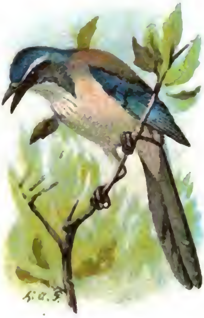
COMMON CROW (Corvus brachyrhynchos).

Length, 19 inches.

Range: Breeds throughout the United States and most of Canada; winters generally in the United States.

Habits and economic status: The general habits of the crow are universally known. Its ability to commit such misdeeds as pulling corn and stealing eggs and fruit and to get away unscathed is little short of marvelous. Much of the crow's success in life is due to cooperation, and the social instinct of the species has its highest expression in the winter roosts, which are sometimes frequented by hundreds of thousands of crows. From these roosts daily flights of many miles are made in search of food. Injury to sprouting corn is the most frequent complaint against this species, but by coating the seed grain with coal tar most of this damage may be prevented. Losses of poultry and eggs may be averted by proper housing and the judicious use of wire netting. The insect food of the crow includes wireworms, cutworms, white grubs, and grasshoppers, and during outbreaks of these insects the crow renders good service. The bird is also an efficient scavenger. But chiefly because of its destruction of beneficial wild birds and their eggs the crow must be classed as a criminal, and a reduction in its numbers in localities where it is seriously destructive is justifiable. (See Farmers' Bul. 54, pp. 22–23.)

CALIFORNIA JAY (Aphelocoma californica).



Length, 12 inches. Distinguished from other jays within its range by its decidedly whitish underparts and brown patch on the back

Range: Resident in California, north to southern Washington, and south to southern Lower California.

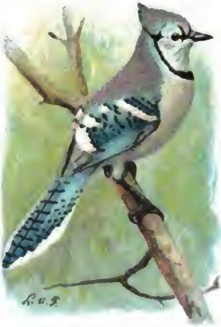
Habits and economic status: This jay has the same general traits of character as the eastern blue jay. He is the same noisy, rollicking fellow and occupies a corresponding position in bird society. Robbing the nests of smaller birds is a favorite pastime, and he is a persistent spy upon domestic fowls and well knows the meaning of the cackle of a hen. Not only does he steal eggs but he kills young chicks. The insect food of this jay constitutes about one-tenth of its annual sustenance. The inclusion of grasshoppers and caterpillars makes this part of the bird's food in its favor. But the remainder of its animal diet includes altogether too large a proportion of beneficial birds and their eggs, and in this respect it appears to be worse than its eastern relative, the blue jay. While its vegetable food is composed largely of mast, at times its liking for cultivated fruit and grain makes it a most unwelcome visitor to the orchard and farm. In conclusion it may be said that over much of its range this jay is too abundant for the best interests of agriculture and horticulture. (See Biol. Survey Bul. 34, pp. 50–56.)

BLUE JAY (Cyanocitta cristata).

Length, 11½ inches. The brilliant blue of the wings and tail combined with the black crescent of the upper breast and the crested head distinguish this species.

Range: Resident in the eastern United States and southern Canada, west to the Dakotas, Colorado, and Texas.

Habits and economic status: The blue jay is of a dual nature. Cautious and silent in the vicinity of its nest, away from it it is bold and noisy. Sly in the commission of mischief, it is ever ready to scream "thief" at the slightest disturbance. As usual in such cases, its remarks are applicable to none more than itself, a fact neighboring nest holders know to their sorrow, for during the breeding season the jay lays heavy toll upon the eggs and young of other birds, and in doing so deprives us of the services of species more beneficial than itself. Approximately three-fourths of the annual food of the blue jay is vegetable matter, the greater part of which is composed of mast, i. e., acorns, chestnuts, beechnuts, and the like. Corn is the principal cultivated crop upon which this bird feeds, but stomach analysis indicates that most of the corn taken is waste grain. Such noxious insects as wood-boring beetles, grasshoppers, eggs of various caterpillars, and scale insects constitute about one-fifth of its food. (See Farmers' Bul. 54, pp. 18–19.)



HORNED LARK (Otocoris alpestris).

Length, about 7¾ inches. The black mark across the breast and the small, pointed tufts of dark feathers above and behind the eyes distinguish the bird.

Range: Breeds throughout the United States (except the South Atlantic and Gulf States) and Canada; winters in all the United States except Florida.

Habits and economic status: Horned larks frequent the open country, especially the plains and deserts. They associate in large flocks, are hardy, apparently delighting in exposed situations in winter, and often nest before snow disappears. The flight is irregular and hesitating, but in the breeding season the males ascend high in air, singing as they go, and pitch to the ground in one thrilling dive. The preference of horned larks is for vegetable food, and about one-sixth of this is grain, chiefly waste. Some sprouting grain is pulled, but drilled grain is safe from injury. California horned larks take much more grain than the eastern birds, specializing on oats, but this is accounted for by the fact that oats grow wild over much of the State. Weed seeds are the largest single element of food. The insect food, about 20 per cent of the whole, includes such pests as May beetles and their larvæ (white grubs), leaf beetles, clover-leaf and clover-root weevils, the potato-stalk borer, nut weevils, billbugs, and the chinch bug. Grasshoppers are a favorite food, and cutworms are freely eaten. The horned larks, on the whole, may be considered useful birds. (See Biol. Survey Bul. 23.)

ARKANSAS KINGBIRD (Tyrannus verticalis).

Length, 9 inches. The white edge of the feather on each side of the tail distinguishes this from all other flycatchers except the gray and salmon-colored scissortail of Texas.

Range: Breeds from Minnesota, Kansas, and Texas to the Pacific Ocean and from northern Mexico to southern Canada; winters from Mexico to Guatemala.

Habits and economic status: The Arkansas kingbird is not so domestic as its eastern relative and seems to prefer the hill country with scattered oaks rather than the orchard or the vicinity of ranch buildings, but it sometimes places its rude and conspicuous nest in trees on village streets. The bird's yearly food is composed of 87 per cent animal matter and 13 per cent vegetable. The animal food is composed almost entirely of insects. Like the eastern species, it has been accused of destroying honeybees to a harmful extent, and remains of honeybees were found to constitute 5 per cent of the food of the individuals examined, but nearly all these eaten were drones. Bees and wasps, in general, are the biggest item of food (38 per cent), grasshoppers and crickets stand next (20 per cent), and beetles, mostly of noxious species, constitute 14 per cent of the food. The vegetable food consists mostly of fruit, such as the elder and other berries, with a few seeds. This bird should be strictly preserved. (See Biol. Survey Bul. 34, pp. 32–34, and Bul. 44, pp. 19–22.)

KINGBIRD (Tyrannus tyrannus).

Length, about 8½ inches. The white lower surface and white-tipped tail distinguish this flycatcher.

Range: Breeds throughout the United States (except the southwestern part) and southern Canada; winters from Mexico to South America.

Habits and economic status: The kingbird is a pronounced enemy of hawks and crows, which it vigorously attacks at every opportunity, thereby affording efficient protection to near-by poultry yards and young chickens at large. It loves the open country and is especially fond of orchards and trees about farm buildings. No less than 85 per cent of its food consists of insects, mostly of a harmful nature. It eats the common rose chafer or rose bug, and more remarkable still it devours blister beetles freely. The bird has been accused of eating honeybees to an injurious extent, but there is little ground for the accusation, as appears from the fact that examination of 634 stomachs showed only 61 bees in 22 stomachs. Of these 51 were useless drones. On the other hand, it devours robber flies, which catch and destroy honeybees. Grasshoppers and crickets, with a few bugs and some cutworms, and a few other insects, make up the rest of the animal food. The vegetable food consists of fruit and a few seeds. The kingbird deserves full protection. (See Biol. Surv. Bul. 44, pp. 11-19.)

NIGHTHAWK (Chordeiles virginianus).

Length, 10 inches. Not to be confused with the whippoorwill. The latter lives in woodland and is chiefly nocturnal. The nighthawk often flies by day, when the white bar across the wing and its nasal cry are distinguishing.

Range: Breeds throughout most of the United States and Canada; winters in South America.

Habits and economic status: The skillful evolutions of a company of nighthawks as the birds gracefully cleave the air in intersecting circles is a sight to be remembered. So expert are they on the wing that no insect is safe from them, even the swift dragonfly being captured with ease. Unfortunately their erratic flight tempts men to use them for targets, and this inexcusable practice is seriously diminishing their numbers, which is deplorable, since no birds are more useful. This species makes no nest, but lays its two spotted eggs on the bare ground, sometimes on the gravel roof of the city house. The nighthawk is a voracious feeder and is almost exclusively insectivorous. Some stomachs contained from 30 to 50 different kinds of insects, and more than 600 kinds have been identified from the stomachs thus far examined. From 500 to 1,000 ants are often found in a stomach. Several species of mosquitoes, including *Anopheles*, the transmitter of malaria, are eaten. Other well-known pests destroyed by the nighthawk are the Colorado potato beetle, cucumber beetles, chestnut, rice, clover-leaf and cotton-boll weevils, billbugs, bark beetles, squash bugs, and moths of the cotton worm.

FLICKER (Colaptes auratus).

Length, 13 inches. The yellow under surface of the wing, yellow tail shafts, and white rump are characteristic.

Range: Breeds in the eastern United States west to the plains and in the forested parts of Canada and Alaska; winters in most of the eastern United States.

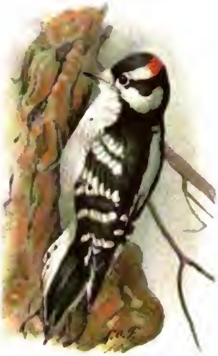
Habits and economic status: The flicker inhabits the open country rather than the forest and delights in park-like regions where trees are numerous and scattered. It nests in any large cavity in a tree and readily appropriates an artificial box. It is possible, therefore, to insure the presence of this useful bird about the farm and to increase its numbers. It is the most terrestrial of our woodpeckers and procures much of its food from the ground. The largest item of animal food is ants, of which the flicker eats more than any other common bird. Ants were found in 524 of the 684 stomachs examined and 98 stomachs contained no other food. One stomach contained over 5,000 and two others held over 3,000 each. While bugs are not largely eaten by the flicker, one stomach contained 17 chinch bugs. Wild fruits are next to ants in importance in the flicker's dietary. Of these sour gum and wild black cherry stand at the head. The food habits of this bird are such as to recommend it to complete protection. (See Biol. Survey Bul. 37, pp. 52–58.)

YELLOW-BELLIED SAPSUCKER (Sphyrapicus varius).

Length, about 8½ inches. Only woodpecker having top of head from base of bill red, combined with a black patch on breast.

Range: Breeds in northern half of the United States and southern half of Canada; winters in most of the States and south to Costa Rica.

Habits and economic status: The yellow-bellied sapsucker is rather silent and suspicious and generally manages to have a tree between himself and the observer. Hence the bird is much better known by its works than its appearance. The regular girdles of holes made by this bird are common on a great variety of trees; in all about 250 kinds are known to be attacked. Occasionally young trees are killed outright, but more loss is caused by stains and other blemishes in the wood which result from sapsucker punctures. These blemishes, which are known as bird pecks, are especially numerous in hickory, oak, cypress, and yellow poplar. Defects due to sapsucker work cause an annual loss to the lumber industry estimated at $1,250,000. The food of the yellow-bellied sapsucker is about half animal and half vegetable. Its fondness for ants counts slightly in its favor. It eats also wasps, beetles (including, however, very few wood-boring species), bugs, and spiders. The two principal components of the vegetable food are wild fruits of no importance and cambium (the layer just beneath the bark of trees). In securing the cambium the bird does the damage above described. The yellow-bellied sapsucker, unlike other woodpeckers, thus does comparatively little good and much harm. (See Biol. Survey Bul. 39.)



DOWNY WOODPECKER (Dryobates pubescens).

Length, 6 inches. Our smallest woodpecker; spotted with black and white. Dark bars on the outer tail feathers distinguish it from the similarly colored but larger hairy woodpecker.

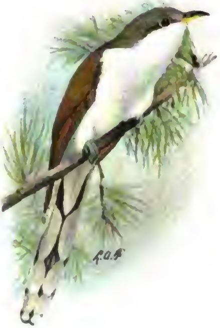
Range: Resident in the United States and the forested parts of Canada and Alaska.

Habits and economic status: This woodpecker is commonly distributed, living in woodland tracts, orchards, and gardens. The bird has several characteristic notes, and, like the hairy woodpecker, is fond of beating on a dry resonant tree branch a tattoo which to appreciative ears has the quality of woodland music. In a hole excavated in a dead branch the downy woodpecker lays four to six eggs. This and the hairy woodpecker are among our most valuable allies, their food consisting of some of the worst foes of orchard and woodland, which the woodpeckers are especially equipped to dig out of dead and living wood. In the examination of 723 stomachs of this bird, animal food, mostly insects, was found to constitute 76 per cent of the diet and vegetable matter 24 per cent. The animal food consists largely of beetles that bore into timber or burrow under the bark. Caterpillars amount to 16 per cent of the food and include many especially harmful species. Grasshopper eggs are freely eaten. The vegetable food of the downy woodpecker consists of small fruit and seeds, mostly of wild species. It distributes seeds of poison ivy, or poison oak, which is about the only fault of this very useful bird. (See Biol. Survey Bul. 37, pp. 17–22.)

YELLOW-BILLED CUCKOO (Coccyzus americanus).

Length, about 12 inches. The yellow lower part of the bill distinguishes this bird from its near relative, the black-billed cuckoo.

Range: Breeds generally in the United States and southern Canada; winters in South America.



Habits and economic status: This bird lives on the edges of woodland, in groves, orchards, parks, and even in shaded village streets. It is sometimes known as rain crow, because its very characteristic notes are supposed to foretell rain. The cuckoo has sly, furtive ways as it moves among the bushes or flits from tree to tree, and is much more often seen than heard. Unlike its European relative, it does not lay its eggs in other birds' nests, but builds a nest of its own. This is, however, a rather crude and shabby affair—hardly more than a platform of twigs sufficient to hold the greenish eggs. The cuckoo is extremely useful because of its insectivorous habits, especially as it shows a marked preference for the hairy caterpillars, which few birds eat. One stomach that was examined contained 250 American tent caterpillars; another, 217 fall webworms. In places where tent caterpillars are abundant they seem to constitute a large portion of the food of this and the black-billed cuckoo.

SCREECH OWL (Otus asio).

Length, about 8 inches. Our smallest owl with ear tufts. There are two distinct phases of plumage, one grayish and the other bright rufous.

Range: Resident throughout the United States, southern Canada, and northern Mexico.

Habits and economic status: The little screech owl inhabits orchards, groves, and thickets, and hunts for its prey in such places as well as along hedgerows and in the open. During warm spells in winter it forages quite extensively and stores up in some hollow tree considerable quantities of food for use during inclement weather. Such larders frequently contain enough mice or other prey to bridge over a period of a week or more. With the exception of the burrowing owl it is probably the most insectivorous of the nocturnal birds of prey. It feeds also upon small mammals, birds, reptiles, batrachians, fish, spiders, crawfish, scorpions, and earthworms. Grasshoppers, crickets, ground-dwelling beetles, and caterpillars are its favorites among insects, as are field mice among mammals and sparrows among birds. Out of 321 stomachs examined, 169 were found to contain insects; 142, small mammals; 56, birds; and 15, crawfish. The screech owl should be encouraged to stay near barns and outhouses, as it will keep in check house mice and wood mice, which frequent such places. (See Biol. Survey Bul. 3, pp. 163-173.)

BARN OWL (Aluco pratincola).

Length, about 17 inches. Facial disk not circular as in our other owls; plumage above, pale yellow; beneath, varying from silky white to pale bright tawny.

Range: Resident in Mexico, in the southern United States, and north to New York, Ohio, Nebraska, and California.

Habits and economic status: The barn owl, often called monkey-faced owl, is one of the most beneficial of the birds of prey, since it feeds almost exclusively on small mammals that injure farm produce, nursery, and orchard stock. It hunts principally in the open and consequently secures such mammals as pocket gophers, field mice, common rats, house mice, harvest mice, kangaroo rats, and cotton rats. It occasionally captures a few birds and insects. At least a half bushel of the remains of pocket gophers have been found in the nesting cavity of a pair of these birds. Remembering that a gopher has been known in a short time to girdle seven apricot trees worth $100 it is hard to overestimate the value of the service of a pair of barn owls. 1,247 pellets of the barn owl collected from the Smithsonian towers contained 3,100 skulls, of which 3,004, or 97 per cent, were of mammals; 92, or 3 per cent, of birds; and 4 were of frogs. The bulk consisted of 1,987 field mice, 656 house mice, and 210 common rats. The birds eaten were mainly sparrows and blackbirds. This valuable owl should be rigidly protected throughout its entire range. (See Biol. Survey Bul. 3, pp. 132-139.)

SPARROW HAWK (Falco sparverius).

Length, about 10 inches. This is one of the best known and handsomest, as well as the smallest, of North American hawks.

Range: Breeds throughout the United States, Canada, and northern Mexico; winters in the United States and south to Guatemala.

Habits and economic status: The sparrow hawk, which is a true falcon, lives in the more open country and builds its nest in hollow trees. It is abundant in many parts of the West, where telegraph poles afford it convenient perching and feeding places. Its food consists of insects, small mammals, birds, spiders, and reptiles. Grasshoppers, crickets, and terrestrial beetles and caterpillars make up considerably more than half its subsistence, while field mice, house mice, and shrews cover fully 25 per cent of its annual supply. The balance of the food includes birds, reptiles, and spiders. Contrary to the usual habits of the species, some individuals during the breeding season capture nestling birds for food for their young and create considerable havoc among the songsters of the neighborhood. In agricultural districts when new ground is broken by the plow, they sometimes become very tame, even alighting for an instant under the horses in their endeavor to seize a worm or insect. Out of 410 stomachs examined, 314 were found to contain insects; 129, small mammals; and 70, small birds. This little falcon renders good service in destroying noxious insects and rodents and should be encouraged and protected. (See Biol. Survey Bul. 3, pp. 115–127.)

RED-TAILED HAWK (Buteo borealis).

Length, about 2 feet. One of our largest hawks; adults with tail reddish brown.

Range: Breeds in the United States, Mexico, Costa Rica, Canada, and Alaska; winters generally in the United States and south to Guatemala.

Habits and economic status: The red-tailed hawk, or "hen-hawk," as it is commonly called, is one of the best known of all our birds of prey, and is a widely distributed species of great economic importance. Its habit of sitting on some prominent limb or pole in the open, or flying with measured wing beat over prairies and sparsely wooded areas on the lookout for its favorite prey, causes it to be noticed by the most indifferent observer. Although not as omnivorous as the red-shouldered hawk, it feeds on a variety of food, as small mammals, snakes, frogs, insects, birds, crawfish, centipedes, and even carrion. In regions where rattlesnakes abound it destroys considerable numbers of the reptiles. Although it feeds to a certain extent on poultry and birds, it is nevertheless entitled to general protection on account of the insistent warfare it wages against field mice and other small rodents and insects that are so destructive to young orchards, nursery stock, and farm produce. Out of 530 stomachs examined, 457, or 85 per cent, contained the remains of mammal pests such as field mice, pine mice, rabbits, several species of ground squirrels, pocket gophers, and cotton rats, and only 62 contained the remains of poultry or game birds. (See Biol. Survey Bul. 3, pp. 48–62.)

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Range: Resident throughout the United States, southern Canada, and northern Mexico.

Habits and economic status: The little screech owl inhabits orchards, groves, and thickets, and hunts for its prey in such places as well as along hedgerows and in the open. During warm spells in winter it forages quite extensively and stores up in some hollow tree considerable quantities of food for use during inclement weather. Such larders frequently contain enough mice or other prey to bridge over a period of a week or more. With the exception of the burrowing owl it is probably the most insectivorous of the nocturnal birds of prey. It feeds also upon small mammals, birds, reptiles, batrachians, fish, spiders, crawfish, scorpions, and earthworms. Grasshoppers, crickets, ground-dwelling beetles, and caterpillars are its favorites among insects, as are field mice among mammals and sparrows among birds. Out of 321 stomachs examined, 169 were found to contain insects; 142, small mammals; 56, birds; and 15, crawfish. The screech owl should be encouraged to stay near barns and outhouses, as it will keep in check house mice and wood mice, which frequent such places. (See Biol. Survey Bul. 3, pp. 163–173.)

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RUFFED GROUSE (Bonasa umbellus).

Length, 17 inches. The broad black band near tip of tail distinguishes this from other grouse.

Range: Resident in the northern two-thirds of the United States and in the forested parts of Canada.

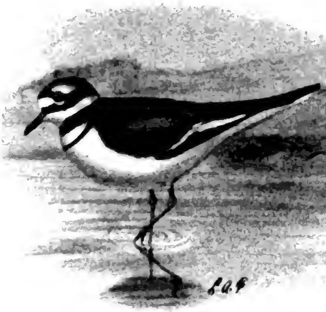
Habits and economic status: The ruffed grouse, the famed drummer and finest game bird of the northern woods, is usually wild and wary and under reasonable protection well withstands the attacks of hunters. Moreover, when reduced in numbers, it responds to protection in a gratifying manner and has proved to be well adapted to propagation under artificial conditions. Wild fruits, mast, and browse make up the bulk of the vegetable food of this species. It is very fond of hazelnuts, beechnuts, chestnuts, and acorns, and it eats practically all kinds of wild berries and other fruits. Nearly 60 kinds of fruits have been identified from the stomach contents examined. Various weed seeds also are consumed. Slightly more than 10 per cent of the food consists of insects, about half being beetles. The most important pests devoured are the potato beetle, clover-root weevil, the pale-striped flea beetle, grapevine leaf-beetle, May beetles, grasshoppers, cotton worms, army worms, cutworms, the red-humped apple worm, and sawfly larvæ. While the economic record of the ruffed grouse is fairly commendable, it does not call for more stringent protection than is necessary to maintain the species in reasonable numbers. (See Biol. Survey Bul. 24, pp. 25–38.)

BOBWHITE (Colinus virginianus).

Length, 10 inches. Known everywhere by the clear whistle that suggests its name.

Range: Resident in the United States east of the plains; introduced in many places in the West.

Habits and economic status: The bobwhite is loved by every dweller in the country and is better known to more hunters in the United States than any other game bird. It is no less appreciated on the table than in the field, and in many States has unquestionably been hunted too closely. Fortunately it seems to be practicable to propagate the bird in captivity, and much is to be hoped for in this direction. Half the food of this quail consists of weed seeds, almost a fourth of grain, and about a tenth of wild fruits. Although thus eating grain, the bird gets most of it from stubble. Fifteen per cent of the bobwhite's food is composed of insects, including several of the most serious pests of agriculture. It feeds freely upon Colorado potato beetles and chinch bugs; it devours also cucumber beetles, wireworms, billbugs, clover-leaf weevils, cotton-boll weevils, army worms, bollworms, cutworms, and Rocky Mountain locusts. Take it all in all, bobwhite is very useful to the farmer, and while it may not be necessary to remove it from the list of game birds every farmer should see that his own farm is not depleted by eager sportsmen. (See Biol. Survey Bul. 21, pp. 9–46.)



KILLDEER (Oxyechus vociferus).

Length, 10 inches. Distinguished by its piercing and oft-repeated cry—*kildee*.

Range: Breeds throughout the United States and most of Canada; winters from central United States to South America.

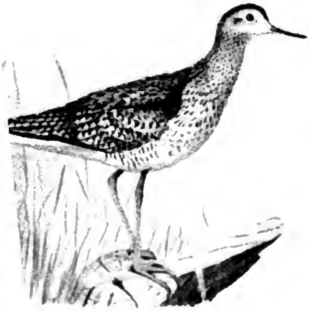
Habits and economic status: The killdeer is one of the best known of the shorebird family. It often visits the farmyard and commonly nests in pastures or cornfields. It is rather suspicious, however, and on being approached takes flight with loud cries. It is noisy and restless, but fortunately most of its activities result in benefit to man. The food is of the same general nature as that of the upland plover, but is more varied. The killdeer feeds upon beetles, grasshoppers, caterpillars, ants, bugs, caddis flies, dragonflies, centipedes, spiders, ticks, oyster worms, earthworms, snails, crabs, and other crustacea. Among the beetles consumed are such pests as the alfalfa weevil, cotton-boll weevil, clover-root weevil, clover-leaf weevil, pine weevil, billbugs, white grubs, wireworms, nd leaf beetles. The bird also devours cotton worms, cotton cutworms, horseflies, mosquitoes, cattle ticks, and crawfish. One stomach contained hundreds f larvæ of the saltmarsh mosquito, one of the most troublesome species. The illdeer preys extensively upon insects that are annoying to man and injurious his stock and crops, and this should be enough to remove it from the list of me birds and insure its protection. (See Farmers' Bul. 497, pp. 16–18.)

UPLAND PLOVER (Bartramia longicauda).

ength, 12 inches. The only plainly colored shorebird which occurs east of plains and inhabits exclusively dry fields and hillsides.

ange: Breeds from Oregon, Utah, Oklahoma, Indiana, and Virginia, north laska; winters in South America.

abits and economic status: This, the most terrestrial of our waders, is shy wary, but it has the one weakness of not fearing men on horseback or in a cle. One of these methods of approach, therefore, is nearly always used by portsman, and, since the bird is highly prized as a table delicacy, it has hunted to the verge of extermination. As the upland plover is strictly ben- l, it should no longer be classed as a game bird and allowed to be shot. y-seven per cent of the food of this species consists of animal forms, chiefly of ous and neutral species. The vegetable food is mainly weed seeds. Almost half of the total subsistence is made up of grasshoppers, crickets, and weevils. Among the weevils eaten are the cotton-boll weevil, greater and lesser clover-leaf weevils, cowpea weevils, and billbugs. This bird devours also leaf beetles, wireworms, white grubs, army worms, cotton worms, cotton cutworms, sawfly larvæ, horseflies, and cattle ticks. In brief, it injures no crop, but consumes a host of the worst enemies of agriculture. (See Farmers' Bul. 497, pp. 14–16.)



BLACK TERN (Hydrochelidon nigra surinamensis).

Length, 10 inches. In autumn occurs as a migrant on the east coast of the United States, and then is in white and gray plumage. During the breeding season it is confined to the interior, is chiefly black, and is the only dark tern occurring inland.

Range: Breeds from California, Colorado, Missouri, and Ohio, north to central Canada; winters from Mexico to South America; migrant in the eastern United States.

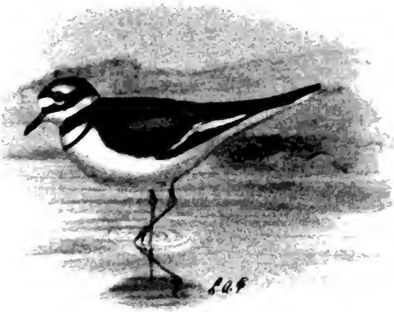
Habits and economic status: This tern, unlike most of its relatives, passes much of its life on fresh-water lakes and marshes of the interior. Its nests are placed among the tules and weeds, on floating vegetation, or on muskrat houses. It lays from 2 to 4 eggs. Its food is more varied than that of any other tern. So far as known it preys upon no food fishes, but feeds extensively upon such enemies of fish as dragonfly nymphs, fish-eating beetles, and crawfishes. Unlike most of its family, it devours a great variety of insects, many of which it catches as it flies. Dragonflies, May flies, grasshoppers, predaceous diving beetles, scarabæid beetles, leaf beetles, gnats, and other flies are the principal kinds preyed upon. Fishes of little economic value, chiefly minnows and mummichogs, were found to compose only a little more than 19 per cent of the contents of 145 stomachs. The great consumption of insects by the black tern places it among the beneficial species worthy of protection.

FRANKLIN'S GULL (Larus franklini).

Length, 15 inches. During its residence in the United States Franklin's gull is practically confined to the interior and is the only inland gull with black head and red bill.

Range: Breeds in the Dakotas, Iowa, Minnesota, and the neighboring parts of southern Canada; winters from the Gulf Coast to South America.

Habits and economic status: Nearly all of our gulls are coast-loving species and spend comparatively little of their time in fresh water, but Franklin's is a true inland gull. Extensive marshes bordering shallow lakes are its chosen breeding grounds, and as many such areas are being reclaimed for agricultural purposes it behooves the tillers of the soil to protect this valuable species. When undisturbed this gull becomes quite fearless and follows the plowman to gather the grubs and worms from the newly turned furrows. It lives almost exclusively upon insects, of which it consumes great quantities. Its hearty appetite is manifest from the contents of a few stomachs: A, 327 nymphs of dragonflies; B, 340 grasshoppers, 52 bugs, 3 beetles, 2 wasps, and 1 spider; C, 82 beetles, 87 bugs, 984 ants, 1 cricket, 1 grasshopper, and 2 spiders. About four-fifths of the total food is grasshoppers, a strong point in favor of this bird. Other injurious creatures eaten are billbugs, squash bugs, leafhoppers, click beetles (adults of wireworms), May beetles (adults of white grubs), and weevils. Franklin's gull is probably the most beneficial bird of its group. (See Farmers' Bul. 497, pp. 19–22.)



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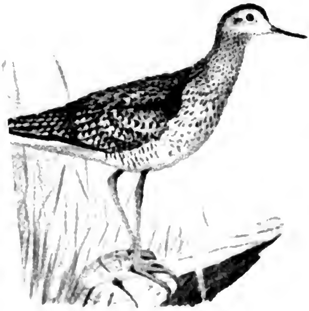

BIRDS MAY BRING YOU MORE HAPPI
THAN THE WEALTH OF THE INDI

BY FRANK M. CHAPMAN

*The following article is reprinted from "Bird Life," a most useful
the study of our common birds, by Frank M. Chapman, illustrated by
page colored plates after drawings by Ernest Seton Thompson. Mr. Ch
Curator of Ornithology in the American Museum of Natural History; a
"Handbook of Birds of Eastern North America," "The Warblers of Nort
ica," "Bird Studies with the Camera," "Camps and Cruises of an Ornith
and editor of "Bird Lore."*

BIRDS possess unusual claims to our attention. They are practically the only ones of the higher animals with which we may come in contact daily. Our large mammals have either been exterminated or driven from the vicinity of our homes, while most of the smaller species are nocturnal and therefore rarely seen. Reptiles and batrachians are difficult to observe and are not popular, while fishes, from the nature of their haunts, can be studied only under certain conditions. Birds, however, are everywhere—in field and wood and sky, in our orchards and gardens—and some of them are with us at all seasons.

But birds' merits do not consist merely in their abundance. In beauty of plumage, grace of motion, and vocal ability they are without rivals; in their migration, mating, and nesting habits they not only display unusual intelligence, but exhibit human traits of character that create within us a feeling of kinship with them, and thus increase our interest in and love for them. Furthermore, as with increasing knowledge we begin to realize their economic value, we are more than ever impressed with the importance of becoming acquainted with them.

How unusual it is to meet any one who can correctly name a dozen of our birds! One may live in the country and still know only two or three of the one hundred and fifty or more kinds of birds that may be found during the year. Nevertheless, these gay, restless creatures, both by voice and action, constantly invite our attention, and they are far too interesting and beautiful to be ignored. No one to whom Nature appeals should be without some knowledge of these, the most attractive of her animate forms.

An inherent love of birds is an undeniable psychological fact, which finds its most frequent expression ir
eral fondness for cage-birds.
learn to regard the birds of t
and fields with all the affection
on our poor captives in the
homes, what an inexhaustible
enjoyment is ours!

It is not alone the beauty,
song, or intelligence of birds
tracts us; it is their human
Man exhibits hardly a trait whi
not find reflected in the life
Love, hate; courage, fear; ang
ure; vanity, modesty; virtue,
stancy, fickleness; generosity, s
wit, curiosity, memory, reason-
find them all exhibited in the
birds.

Birds have thus become sy
certain human characteristics,
more common species are so i
in our art and literature that b
least they are known to all of u
speare makes over six hundr
ences to birds or bird-life. If
rob Wordsworth's verses of t
how sadly mutilated what
would be!

THE NEVER FAILING CHARM OF

But why leave a knowledge
poets and naturalists? Go y
the field and learn that birds d
solely in books, but are concret
beings, whose acquaintance n
you more unalloyed happiness
wealth of the Indies.

John Burroughs understands
he writes of the study of bird
is a fascination about it quite o
ing. It fits so well with othe
with fishing, hunting, farming
camping out—with all that tak
the fields and woods. One
blackberrying and make some

W

His calm, restful song rings
clear from a thankful heart. It
benediction at the close of day.

covery; or while driving his cow to pasture, hear a new song or make a new observation. Secrets lurk on all sides. There is news in every bush. What no man ever saw before may the next moment be revealed to you. What a new interest the woods have! How you long to explore every nook and corner of them!"

The scientific results to be derived from the study of birds are fully realized by the naturalist. But there are other results equally important. I would have every one know of them: results that add to our pleasure in field and wood, and give fresh interest to walks that before were eventless; that quicken both ear and eye, making us hear and see where before we were deaf and blind. Then, to our surprise, we shall discover that the forests and pastures we have known all our lives are tenanted by countless feathered inhabitants, whose companionship will prove a source of endless enjoyment.

I would enter a special plea for the study of birds in the schools; for the more general introduction of ornithology in natural-history courses. Frogs and crayfish serve an excellent purpose, but we may not encounter either of them after leaving the laboratory; whereas birds not only offer excellent opportunities for study, but are always about us, and even a slight familiarity with them will be of value long after school days are over.

Photo by Dwig

A KINGFISHER LEAVING ITS NES

The shores of wooded streams or pond
chosen haunts of the kingfisher. Silently b
on some limb overhanging the water, ever o
for food or foe. Paddle toward him as quie
please, just as you reach his danger line he d
his perch and with loud, rattling call flies
This may be repeated several times, until
limits of his wanderings are reached, when
a wide detour and returns to the starting po

THE BIRD'S PLACE IN NATURE

About thirteen thousand species of birds are known to science. The structure of many of these has been carefully studied, and all have been classified, at least provisionally. Taken as a whole, the class Aves, in which all birds are

placed, is more clearly defined
other group of the higher anim
is, the most unlike birds are mo
allied than are the extremes amo
mals, fishes, or reptiles, and a
birds possess the distinctive char
their class.

When compared with other
birds are found to occupy sec
in the scale of life They stand
mammals and reptiles, and a
closely related to the latter tha
former; in fact, certain extinct
clearly connect living birds with
that these two classes are so
placed in one group—the Sauro

The characters that distingu

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*On the structure of birds read Coues's Key to North American Birds, part II (Estes & Lauriat); Headley, The Structure and Life of Birds; Newton's Dictionary of Birds. Articles: Anatomy of Birds and Fossil Birds; Martin and Moale's Handbook of Vertebrate Dissection, part II; How to Dissect a Bird.

Photo by J. M. Schreck

BLACK TERN ON ITS NEST (SEE PAGE 697)

of reeds and grasses rather closely woven, is found in grassy marshes or in floating in a slough. It is an abundant species in the interior of the United States chiefly on dragon flies and various aquatic insects.

mals on the one hand and les on the other are more ap- t real. Thus flight, the most a bird's gifts, is shared by ; mammals. Egg laying is the of reptiles and of three mam- Australian duckbill and the But incubation by one or parents is peculiar to birds. python is said to coil on its

the more rapidly than either reptiles, and their pneuma- power of inflating numerous even certain bones, is unique. rature of birds ranges from while in mammals it reaches and in the comparatively reptiles it averages only 40 in mammals articulates with (the atlas) by two condyles birds and reptiles by only mammals and birds the heart chambers; in reptiles it has but

[illegible]

reptiles both have teeth, possessed by no existing birds apparently prove that early in the development of the class all birds had teeth.

Thus we might continue the comparison, finding that birds have no universal peculiarities of structure which are not present in some degree in either mammals or reptiles, until we come to their external covering. The reptile is scaled, and so is the fish; the mammal is haired, and so are some insects; but birds alone possess feathers. They are worn by every bird—a fit clothing for a body, which is a marvelous combination of beauty, lightness, and strength.

There is good evidence for the belief that birds have descended from reptilian ancestors. This evidence consists of the remains of fossil birds, some of which show marked reptilian characters and, as just said, are toothed. It is unnecessary to discuss here the relationship of the bird-like reptiles, but, as the most convincing argument in support of the theory of the reptilian descent of birds, I mention a restoration of the Archæopteryx, the earliest known progenitor of the class Aves. This restoration is based on an examination of previous restorations in connection with a study of the excellent plates which have been published of the

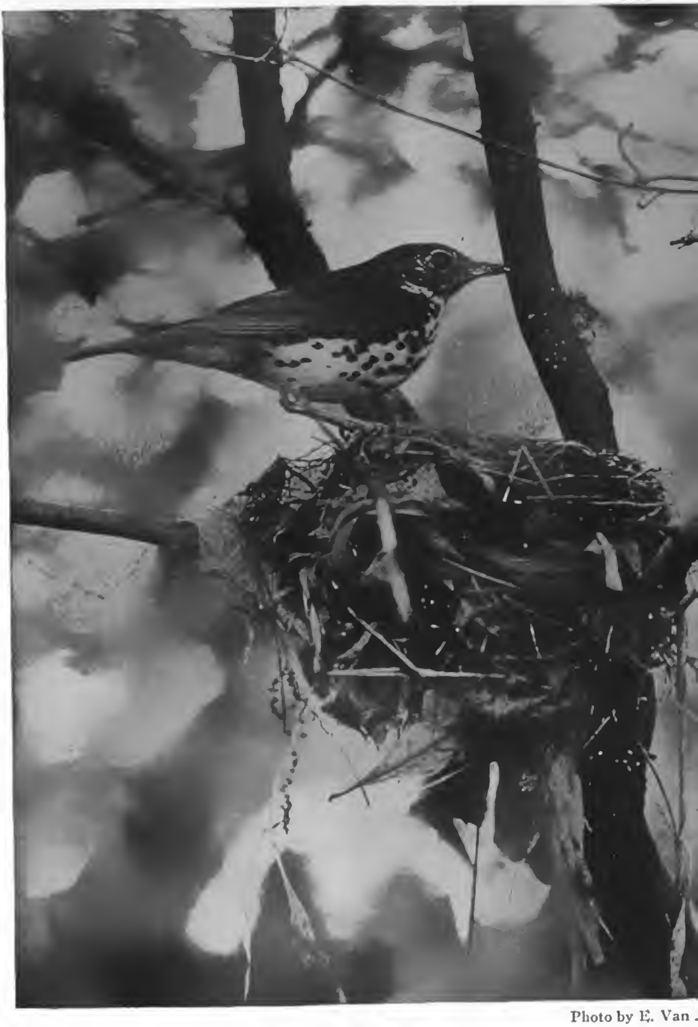

Photo by E. Van

WOOD THRUSH AND NEST

His calm, restful song rings through the woods like a hymn of praise rising clear from a thankful heart. It is a message of hope and good cheer in the benediction at the close of day.

Photo by J. M. Schreck

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st, of reeds and grasses rather closely woven, is found in grassy marshes or in
floating in a slough. It is an abundant species in the interior of the United States
s chiefly on dragon flies and various aquatic insects.

nmals on the one hand and
les on the other are more ap-
n real. Thus flight, the most
a bird's gifts, is shared by
g mammals. Egg-laying is the
ost reptiles and of three mam-
Australian duckbill and the
But incubation by one or
parents is peculiar to birds.
python is said to coil on its

athe more rapidly than either
or reptiles, and their pneuma-
power of inflating numerous
l even certain bones, is unique.
perature of birds ranges from
, while in mammals it reaches
, and in the comparatively
d reptiles it averages only 40
l in mammals articulates with
tebra (atlas) by two condyles
n birds and reptiles by only
ammals and birds the heart
mbers; in reptiles it has but

DESCENDED FROM REPTILES

s and reptiles both have teeth,
possessed by no existing
fossil birds apparently prove

that early in the development of the class all birds had teeth.

Thus we might continue the comparison, finding that birds have no universal peculiarities of structure which are not present in some degree in either mammals or reptiles, until we come to their external covering. The reptile is scaled, and so is the fish; the mammal is haired, and so are some insects; but birds alone possess feathers. They are worn by every bird—a fit clothing for a body, which is a marvelous combination of beauty, lightness, and strength.

There is good evidence for the belief that birds have descended from reptilian ancestors. This evidence consists of the remains of fossil birds, some of which show marked reptilian characters and, as just said, are toothed. It is unnecessary to discuss here the relationship of the bird-like reptiles, but, as the most convincing argument in support of the theory of the reptilian descent of birds, I mention a restoration of the Archæopteryx, the earliest known progenitor of the class Aves. This restoration is based on an examination of previous restorations in connection with a study of the excellent plates which have been published of the

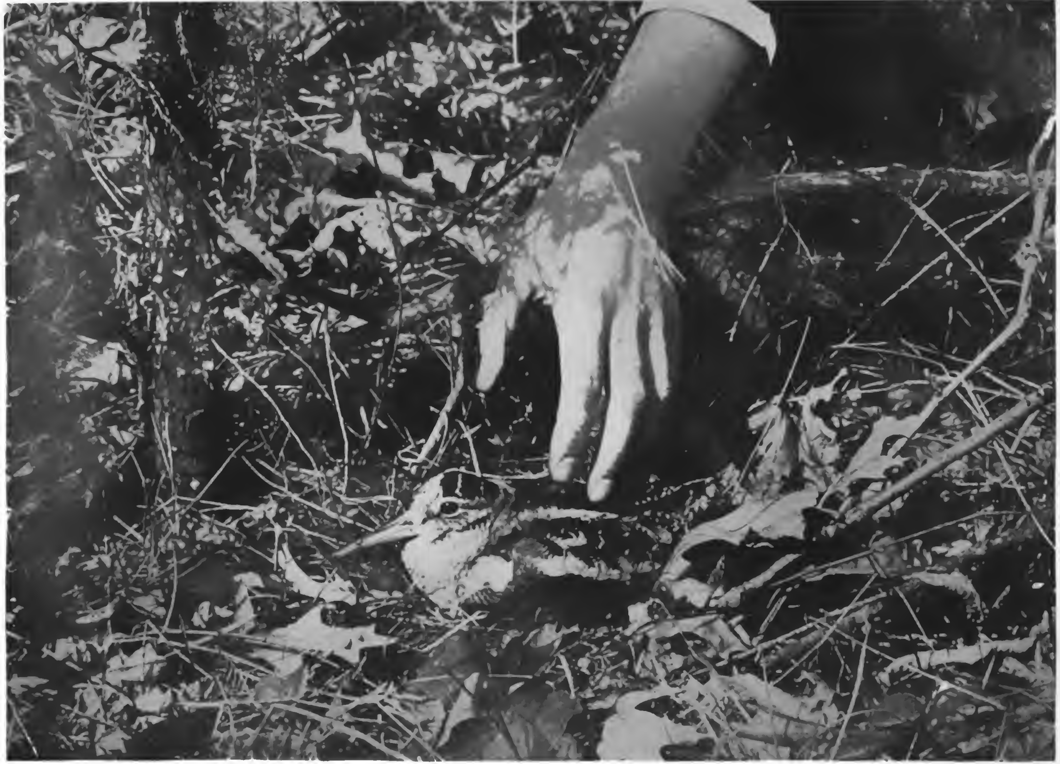

Photo by E. Van Altena

STROKING A WOODCOCK ON ITS NEST

Photo by A. L. Princehorn

S AND NEST (SEE PAGE 673)

he last of June the young of the first brood, with the old mates, resort in tly to a roosting place. These roosts are generally in deciduous second growths, s but sometimes on [illegible] ground. The females are now occupied with the cares amily, and the males [illegible] to return each day to assist them in their duties. ember, when the nesting season is over, robins gather in large flocks, and from l their departure for the South roam about the country in search of food, taking cherries, dogwood and cedar berries. The songs and call-notes of the robin, own to every one, are in reality understood by no one, and offer excellent sub-student of bird language. Its notes express interrogation, suspicion, alarm, e signals to its companions to take wing; indeed, few of our birds have a more bulary.

animals. They roam the
le to pole; they are equally
wave washed coral reef or
sert, amid arctic snows or
of a tropical forest. This
e to their powers of flight,
laptability to varying con-
Although, as I have said,

birds are more closely related among themselves than are the members of either of the other higher groups of animals, and all birds agree in possessing the more important distinguishing characters of their class, yet they show a wide range of variation in structure.

This, in most instances, is closely related to habits, which in birds are doubtless more varied than in any of the other higher animals. Some birds, like penguins, are so aquatic that they are practically helpless on land. Their wings are too small to support them in the air, but they fly under water with great rapidity, and might be termed feathered porpoises. Others, like the ostrich, are terrestrial, and can neither fly nor swim. Others still, like the frigate-birds, are aërial. Their small feet are of use only in perching, and their home is in the air.

If, now, we should compare specimens of penguins, ostriches, and frigate-birds

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ution of animals read Allen,
l Distribution of North Amer
ulletin of the American Mu
History (New York city), iv,
our maps; Allen, The Geo
and Distribution of North
Considered in Relation to
North America, The Auk
1893, pp. 97-150; two
The Geographic Distribution
America, with Special Ref
, Proceedings of the Bio
Washington, vii, 1892, pp
Merriam, Laws of Temperat
Geographic Distribution of
and Plants, National
Washington, vi, 1894,

Photo by A. L. Princehorn

A PAIR OF FLICKERS, OR YELLOW-HAMMERS, IN THEIR HOME (SEE PAGE 69

The habits, notes, and colors of this well-known bird are reflected in the popular
which have been applied to it throughout its wide range. No less than 36 of these
have been recorded. The flicker is a bird of character. Although a woodpecker, he
original to follow in the footsteps of others of his tribe. They do not frequent the g
but that is no reason why he should not humor his own terrestrial propensities, and w
therefore frequently flush him from the earth, when, with a low chuckle, he goes bou
off through the air, his white rump showing conspicuously as he flies.

with each other, and with such widely different forms as humming-birds, woodpeckers, parrots, and others, we would realize still more clearly the remarkable amount of variation shown by birds. This great difference in form is accompanied by a corresponding variation in habit, making possible, as before remarked, the wide distribution of birds, which, together with their size and abundance, renders them of incalculable importance to man. Their economic value, however, may be more properly spoken of under—

THE RELATION OF BIRDS TO MAN

The relation of birds to man is threefold—the scientific, the economic, and the æsthetic. No animals form more profitable subjects for the scientist than birds. The embryologist, the morphologist and the systematist the philosophic naturalist, and the psychologist all may find in them exhaustless material for study. It is not my purpose, however, to speak here of the science of ornithology. Let us learn something of the bird in its haunts before taking it to the laboratory. The living bird cannot
attract us; the dead bird—voiceles
tionless—we will leave for futur
section.

The economic value of birds t
lies in the service they render in p
ing the undue increase of insects,
vouring small rodents, in destroyi
seeds of harmful plants, and in ac
scavengers.

Leading entomologists estimate t
sects cause an annual loss of at lea
hundred million dollars to the a
tural interests of the United States
statement seems incredible, but is
upon reliable statistics. This, of
does not include the damage d
ornamental shrubbery, shade and
trees. But, if insects are the
enemies of vegetation, birds are t
ural enemies of insects. Conside
moment what the birds are doing
any summer day, when insects
abundant that the hum of their
voices becomes an almost inheren
of the atmosphere.

In the air swallows and swi

Photo by A. L. Princehorn

ROBIN AND NEST (SEE PAGE 673)

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Photo by R. H. Be

BROWN THRASHER (SEE PAGE 677)

Hedge-rows, shrubbery about the borders of woods, scrubby growth, or thickets fields, are alike frequented by the thrasher. Generally speaking, he is an inhabitant undergrowth, where he passes much time on the ground foraging among the fallen He is an active, suspicious bird, who does not like to be watched, and expresses his ance with an unpleasant kissing note or sharply whistled *wheèu.*

Professor Forbes, Director of the Illinois State Laboratory of Natural History, found 175 larvæ of *Bibio*—a fly which in the larval stage feeds on the roots of grass—in the stomach of a single robin, and the intestine contained probably as many more.

Many additional cases could be cited showing the intimate relation of birds to insect life and emphasizing the necessity of protecting and encouraging these little-appreciated allies of the agriculturist.

The service rendered man by birds in killing the small rodents so destructive to crops is performed by hawks and owls—birds the uninformed farmer considers his enemies. The truth is that, with two exceptions—the sharp-shinned and Cooper's hawk—all our commoner hawks and owls are beneficial. In his exhaustive study of the foods of these birds, Dr. A. K. Fisher, Assistant Ornithologist of the United States Department of Agriculture, has found that 90 per cent of the food of the red-shouldered hawk, commonly called "chicken-hawk" or "hen-hawk," consists of injurious mammals and insects, wl castings of the barn-owl contai skulls of 454 small mammals, no le 225 of these being skulls of the d ive field or meadow mouse.

HOW THE BIRDS HELP MANKI

Still, these birds are not only r tected, but in some States a price ally set upon their heads!

As destroyers of the seeds of l plants, the good done by birds ca overestimated. From late fall t spring seeds form the only food c birds, and every keeper of cag can realize how many a bird n in a day. Thus, while the chic nuthatches, woodpeckers, and som winter birds are ridding the t myriads of insects' eggs and lar granivorous birds are reaping a seeds which, if left to germinate cause a heavy loss to our agri interests.

As scavengers, we understand t tain birds are of value to us, and fore we protect them. Thus the

see a bird in every bush and find the heavens their pathway. One moment we may admire their beauty of plumage, the next marvel at the ease and grace with which they dash by us or circle high overhead.

But birds will appeal to us most strongly through their songs. When your ears are attuned to the music of birds, your world will be transformed. Birds' songs are the most eloquent of Nature's voices: the gay carol of the grosbeak in the morning; the dreamy midday call of the pewee; the vesper hymn of the thrush; the clanging of geese in the springtime; the farewell of the bluebird in the fall—how clearly each one expresses the sentiment of the hour or season!

FEATHERED COMRADES

Having learned a bird's language, you experience an increased feeling of comradeship with it. You may even share its emotions as you learn the significance of its notes. No one can listen to the song of the mocking-bird without being in some way affected; but in how many hearts does the *tink* of the night-flying bobolink find a response? I never hear it without wishing the brave little traveler godspeed on his long journey.

As time passes you will find that the songs of birds bring a constantly increasing pleasure. This is the result of asso-

Photo by Frank M. Chapman

AN OVEN-BIRD LOOKING OUT OF HER NEST

As an architect, the oven-bird is distinguished. Her unique nest is built on the gr
of coarse grasses, weed stalks, leaves, and rootlets, and is roofed over, the entrance
at one side. It thus resembles an old-fashioned Dutch oven, and its shape is the orig
its builder's name.

tive barrenness of their world, for they live in ignorance of the great store of enjoyment which might be theirs for the asking.

I count each day memorable that brought me a new friend among the birds. It was an event to be recorded in detail. A creature which up to that moment existed for me only as a name, now became an inhabitant of my woods, a part of my life. With what a new interest I got down my books again, eagerly reading every item concerning this new friend—its travels, habits, and notes; comparing the observations of others with what were now my own!

The study of birds is not restricted to any special season. Some species are al-

ways with us. Long after the
have fallen and the fields are bar
brown, when insect voices are h
and even some mammals are sl
their winter sleep, the cheery junc
about our doorstep. the white-t
twitter cozily from the evergreens
sparrows chatter gayly over their
fast of seeds, and crows are calling
the woods. Birds are the only
creatures to be seen. What a se
companionship their presence gives
desolate the earth would seem w
them!

The ease with which we may b
familiar with these feathered neig
of ours robs ignorance of all ex
Once aware of their existence, we

State printer, large 8vo, pp. 434, plates 100.
he English Sparrow in North America, espe-
ially in its Relation to Agriculture, prepared
nder the direction of C. Hart Merriam, by
Valter B. Barrows; Bulletin No. 1, Division
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tates in their Relation to Agriculture, pre-
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the Food of Woodpeckers, by F. E. L.
eal; Bulletin No. 7, *ibid.*, 1895. (See also
many other papers on the food of birds
Annual Report and Yearbook of the
States Department of Agriculture.)
Protectors of Orchards, by E. H. Fo
Bulletin No. 3, Massachusetts State Bo
Agriculture, 1895, pp. 20-32. The C
Massachusetts, by E. H. Forbush;
No. 4, *ibid.*, 1896. How Birds Affect th
and Garden, by Florence A. Merria
printed from "Forest and Stream," 189
pp. 31. Price, 5 cents. Useful Birds ar
Protection, by E. H. Forbush; Massac
Board of Agriculture, 1907, and in the
publications of the United States Bi
Survey.

CHINESE PIGEO

WE ARE wont to speak of the Chinese as a sober, practical, and prosaic people, and to view them throughout in that light. Immensely rational they are, secular and worldly minded, bestowing their efforts on useful temporal affairs; but, nevertheless, they are by no means lacking in purely emotional matters of great attractiveness.

As early as the 11th century one of their greatest poets sang:

"Upon the bridge the livelong day
I stand and watch the goldfish play."

The domestication of the goldfish, the first species of which reached England only in 1691, and of the wonderful paradise-fish as well, is justly ascribed to the Chinese, and it is remarkable to notice that their attempts in this direction and the amazing results achieved were not prompted by any utilitarian views they had in mind, as neither fish is of any practical advantage. On the contrary their skillful breeding, so eagerly pur sued, is due solely and exclusively to th aesthetic tendency of the Chinese in the art of living and to their highly cult vated sense of beauty, which delights the bright coloration of the skin of the fishes, the graceful form of their bodi and the restless motions of their lo flowing fins.

While the almost Darwinian exp ments to which Chinese breeders h subjected the goldfish, and their bounded admiration of this little c ture in its hundred and one forms variations, illustrate well the intimat lation of the people to the elemen water, their friendly associations the world of birds are not less clos sympathetic. The lover of birds not permanently confine his pet prison cage, but he takes it out wit on his walks, carrying it on a sti which one of its feet is fasten means of a thread long enough to it ample freedom of motion. Wh shade of some stately tree bids hi come, he makes a halt and perm bird to perch and swing on a supp watching it for hours.

One of the most curious exp of emotional life is the applic

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A BIRD IN THE HAND

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s time passes you will find that the gs of birds bring a constantly increas- pleasure. This is the result of association. The places and people that r our world are every changing; the p ent slips from us with growing rapi but the birds are ever with us.

The robin singing so cheerily ou my window sings not for himself a but for hundreds of robins I have kn at other times and places. His song calls a March evening, warm with promise of spring; May mornings, w all the world seemed to ring with voices of birds; June days, when che were ripening; the winter sunlit fo of Florida and even the snow-ca summit of glorious Popocatepetl. so it is with other birds. We may, true, have known them for years; they have not changed, and their fa iar notes and appearance encourage pleasant self-delusion that we, too, the same.

The slender saplings of earlier y now give wide-spreading shade; scrubby pasture lot has become a d woodland. Boyhood's friends are no longer, and there has even appe another generation of boys whose ence is discouraging proof that fo youth has past. Then some May m ing we hear the wood-thrush sing. he, too, changed? Not one note; an his silvery voice rings through the wo we are young again. No fountai youth could be more potent. A hun incidents of the long ago become as

THE NATION'

By James

Author of "The American Commonwea
ica," etc., and Ambassador fro

An address to the Committee of One
ington, D. C. Specially revised by Mr.
Geographic Magazine.

I HAVE been asked to give you the impressions of a visitor who, having seen something of the capitals of other countries and having spent six happy and interesting years in Washington, and having grown always more and more interested in your own plans for the adornment of Washington, may possibly be able to look at the matter from a somewhat different angle from that at which most of you have seen it.

It is, I think, impossible for any one who speaks our common language, who is familiar with your institutions and history, who recognizes how much there is in common between us—your nation anc
mine—to live here without becoming fo
many purposes—morally and intellectu
ally, and for practically all purposes ex
cept, of course, political purposes—a cit
zen of the United States. That does n
prevent him, I need hardly say, from r
maining a patriotic citizen of his ov
country. He is exempt from the du
from which, indeed, you are all exen
in the District of Columbia—of cast
a vote—and from the other duty of g
ting on the platform to give his polit
views to his fellow-countrymen; but
every other respect his residence h
gives him all the advantages which
have, in being able to follow the ins
outs of your politics and to appre
the surprising changes which the wh
gig of time brings about.

Taking so keen an interest as I
the welfare of the United States, I
often felt it somewhat difficult to r
from offering advice which wa
asked for. I trust that I have a
refrained, but in this particular ca
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CHINESE PIGEON WHISTLES

WE ARE wont to speak of the Chinese as a sober, practical, and prosaic people, and to view them throughout in that light. Immensely rational they are, secular and worldly minded, bestowing their efforts on useful temporal affairs; but, nevertheless, they are by no means lacking in purely emotional matters of great attractiveness.

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While the almost Darwinian experiments to which Chinese breeders have subjected the goldfish, and their unbounded admiration of this little crea-ure in its hundred and one forms and variations, illustrate well the intimate re-ation of the people to the element of water, their friendly associations with he world of birds are not less close and ympathetic. The lover of birds does not permanently confine his pet in its prison cage, but he takes it out with him on his walks, carrying it on a stick, to which one of its feet is fastened by means of a thread long enough to allow ample freedom of motion. Where the hade of some stately tree bids him wel-ome, he makes a halt and permits the ird to perch and swing on a supple twig, watching it for hours.

One of the most curious expressions f emotional life is the application of whistles to a flock of pigeons. T whistles, very light, weighing a grams, are attached to the tails of y pigeons soon after their birth, by n of fine copper wire, so that wher birds fly the wind blowing througl whistles sets them vibrating, and produces an open-air concert, for th struments in the same flock are all d ent. On a serene day in Peking, w these instruments are manufactured great cleverness and ingenuity, it is sible to enjoy this aërial music whil ting in one's room.

There are two distinct types of tles—those consisting of bamboo placed side by side and a type base the principal of tubes attached gourd. They are lacquered in ye brown, red, and black to protect the terial from the destructive influenc the atmosphere. The tube whistles either two, three, or five tubes. In specimens the five tubes are made o horn instead of bamboo. The g whistles are furnished with a m piece and small apertures to the nu of two, three, six, ten, and even thi Certain among them have besides a ber of bamboo tubes, some of the cipal mouthpiece, some arranged ar it. These varieties are distinguishe different names. Thus a whistle one mouthpiece and ten tubes is c "the eleven-eyed one."

The explanation which the Chines fer of this quaint custom is not satisfactory. According to them, whistles are intended to keep the together and to protect the pigeons attacks of birds of prey. There s however, little reason to believe th hungry hawk could be induced by innocent music to refrain from sa ing his appetite; and this doubtless s of an after-thought which came up after the introduction of this u through the attempt to give a rat and practical interpretation to some that had no rational origin whatever it is not the pigeon that profits from practice, but merely the human which feasts on the wind-blown and derives æsthetic pleasure from music.

No European city has so noble a cataract in its vicinity as the Great Falls of the Potomac—a magnificent piece of scenery which you will, of course, always preserve.

Vienna has some picturesque country, hills and woods and rocks within a distance of 25 or 30 miles. London also has very pleasing landscapes of a softer type within about that distance; but I know of no great city in Europe (except Constantinople) that has quite close, in its very environs, such beautiful scenery as has Washington in Rock Creek Park and in many of the woods that stretch along the Potomac on the north and also on the south side, with the broad river in the center and richly wooded slopes descending boldly to it on each side.

One may wander day after day in new walks all through these woods to the northwest and west of the city. One need never take the same walk twice, for there is an endless variety of foot-paths, each with its own vistas of woodland beauty.

THE WOODED CHARM OF THE WASHINGTON STREETS

Nor is Washington less charming in respect of its interior. I know of no city in which the trees seem to be so much a part of the city as Washington. Nothing can be more delightful than the views up and down the wider streets and avenues, especially those that look toward the setting sun or catch some glow of the evening light.

Look southwestward down New Hampshire avenue, look northwestward up Connecticut avenue, or even westward along modest little N street, which passes the house where I live, and whose vista is closed by the graceful spire of Georgetown University, and you have the most charming sylvan views, and all this is so by reason of the taste and forethought of those who have administered the government of the city and who have planted various species of trees, so that you have different kinds of sylvan views.

When you want a fine, bold effect, what could be grander than 16th street, with its incline rising steeply to the north, and the hills of Virginia as the background, where it falls gently away to the

THE NATION'S CAPITAL

By James Bryce

Author of "The American Commonwealth," "Impressions of South Ame ica," etc., and Ambassador from Great Britain, 1906–1913

An address to the Committee of One Hundred on the Development of Was ington, D. C. Specially revised by Mr. Bryce for publication in the Nation Geographic Magazine.

I HAVE been asked to give you the impressions of a visitor who, having seen something of the capitals of ther countries and having spent six appy and interesting years in Washington, and having grown always more and iore interested in your own plans for ie adornment of Washington, may posbly be able to look at the matter from somewhat different angle from that at hich most of you have seen it.

It is, I think, impossible for any one ho speaks our common language, who familiar with your institutions and history, who recognizes how much there is common between us—your nation and ine—to live here without becoming for any purposes—morally and intellectuly, and for practically all purposes except, of course, political purposes—a citin of the United States. That does not revent him, I need hardly say, from reaining a patriotic citizen of his own ountry. He is exempt from the duty om which, indeed, you are all exempt the District of Columbia—of casting vote—and from the other duty of getig on the platform to give his political ews to his fellow-countrymen; but in ery other respect his residence here ves him all the advantages which you ve, in being able to follow the ins and its of your politics and to appreciate e surprising changes which the whirlig of time brings about.

Taking so keen an interest as I do in e welfare of the United States, I have ten felt it somewhat difficult to refrain om offering advice which was not ked for. I trust that I have always frained, but in this particular case the servations—I will not call them adce—the observations on the city of ashington and what can be done for it ve been asked for, and if you find they e only what you knew before, do not altogether blame me, but lay it to misjudgment of the too kind friends have asked me to come upon the p form.

AN IDEAL SITE FOR A CITY

It is impossible to live in Washing and not be struck by some peculiar tures and some peculiar beauties wl your city possesses. In the first pl its site has a great deal that is admir and charming. There is rising gro inclosing on all sides a level space, so making a beautiful amphitheater, tween hills that are rich with wo which in many places, thanks to the h ancient rocks of this region, show b faces and give much more striking eff than we can have in the soft, chalky sandy hills which surround Lon Underneath these hills and running a silver thread through the middle of valley is your admirable river.

The Potomac has two kinds of beaut the beauty of the upper stream, murm ing over a rocky bed between bold heig crowned with wood, and the beauty the wide expanse, spread out like a below the city into a vast sheet of sil

Besides all this, you have behind W ington a charming country. I am so times surprised that so few of your dents explore that country on foot. is only on foot that you can appre its beauties, for some of the most tractive paths are too narrow and tan for riding. On the north, east, and sides of Washington, and to some ex on the south, or Virginia, side also, though there the difficulties of locomo are greater on account of the heavy in the roads, the country is singul charming, quite as beautiful as that w adjoins any of the great capital citie Europe, except, of course, Constant ple, with its wonderful Bosphorus.

many places water-logged, owing to numerous pools and swamps. It has no natural attraction either in its immediate or more distant environs, except the stream of Neva.

Paris, again, has some agreeable landscapes within reach, but nothing at all striking, nothing nearly so fine in the lines of its scenery as the hills that inclose the valley in which Washington lies, and no such charm of a still wild forest as Washington affords. The Seine, too, is a stream not to be compared to your Potomac.

The same thing may be said of Madrid. It stands on a level, and the mountains are too distant to come effectively into the landscape, and its only water is a wretched little brooklet called the Manzanares. They tell a story there about a remark attributed to Alexandre Dumas when he visited Madrid. He was taken to the lofty bridge which spans the ravine at the bottom of which the rivulet flows. The day was hot and, being thirsty, he asked for a glass of water. They brought him the water, and he was about to drink, when looking down and catching sight of the streamlet, he said, "No, take it away; give it to that poor river: it needs a drink more than I do."

Then there is our English London, which stands in a rather tame country. It is true that there are some charming bits of quiet and pretty rural scenery in Surrey and Sussex, within a distance of from 20 to 30 miles, and there are pleasing beech woods covering the chalky hills of Bucks. Yet Nature has done nothing for London comparable to what she has done for Washington. The Thames, although it fills up pretty well at high tide, is nowise comparable for volume or beauty of surroundings to your own Potomac.

These cities I have named have, however, something that you have not and cannot have for many a year to come. They are—and this applies especially to London and Paris—ancient cities. They have still, in spite of the destroying march of modern improvements, a certain number of picturesque buildings, crooked old streets, stately churches, and spots hallowed by the names of famous men who were born there or died there or did their work there.

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I do not mean to say that there are not many other capitals in this world to which Nature has been even more generous. You have not a beautiful arm of the sea at your doors, as has Constantinople, nor the magnificent mountains that surround the capitals of Rio Janeiro or Santiago de Chile, nor such a bay, or rather landlocked gulf, as that of San Francisco, with its splendid passage out to the ocean; but those are very rare things, of which there are few in the world. As capitals go, few, indeed, are so advantageously situated in respect to natural charms as is Washington.

All these considerations make one feel how great are the opportunities here offered to you for the further adornment and beautification of this city. Nature has done so much, and you have, yourselves, already done so much that you are called upon to do more. You have such a chance offered to you here for building up a superb capital that it would be almost an act of ingratitude to Providence and to history and to the men who planted the city here if you did not use the advantages that you here enjoy.

HOW WASHINGTON COMPARES WITH THE WORLD'S GREAT CAPITALS

Perhaps you might like to hear a few remarks on some of the other great capitals of the world. Take Berlin. It stands in a sandy waste, perfectly flat, with here and there a swampy pond or lake, and a sluggish stream meanders through it. Parts of the environs have, however, been well planted with trees, and this redeems the city to some extent. The streets are now stately, adorned by many a noble building. It has become, through the efforts of the government and its own citizens, an imposing city; but the environs can never be beautiful, because Nature has been very ungracious.

Take St. Petersburg. St. Petersburg has a splendid water front facing its grand river, the Neva, with its vast rush of cold green water, covered with ice in winter and chilling the air, and seeming to chill the landscape in summer. That, however, is the only beauty St. Petersburg has. The country is flat and in

IN THE RAP

dark over your city as it does o Pittsburgh and Chicago. Moreover, yo streets would be overcrowded and di culties of rapid transit would arise.

With a much larger population, ide of beauty would have to give way those of commercial interests, where here the pressure of commerce is n such as to interfere with your ideals beauty and convenience.

With all these advantages before yo in Washington, and with the bottomle purse of Uncle Sam behind you—I a coming presently to the use that Unc Sam's representatives may make of h purse for your benefit, but in the mear time we may assume it is an inexhausti ble purse, because we know how mucl money he is able to spend upon object that are certainly of no more importanc than the beautification of Washington—with all those advantages ready to your hand, what may you not make of Washington? What may you not make of a city which is dedicated entirely to politics and government and society?

Mr. Henry James, in one of his interesting and subtle studies of modern

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You are still in the early days of your history and are only beginning to accumulate historic memories which in four or five centuries will be rich and charged with meaning like those of European cities.

But in every other respect you have in Washington advantages which these European cities do not possess. If you want to make any large street improvement in London or Paris it is a most costly business. The land is very dear. You cannot easily disturb the old lines of streets and the drains and water pipes and telephone lines that lie under them. Every improvement that has to be made in a city like London has to be made at a cost so heavy that where it is added to the necessary expenses of maintaining modern appliances and carrying out sanitary regulations in an old city the cost is almost prohibitory.

But here you have still plenty of space, and though the city is extending very fast on almost all sides, still if you take forethought and consider your future, you can lay out the tracts over which Washington is beginning to spread in a way that will have results far more beautiful than are attainable in the growing parts of Londan and Paris, where land is so expensive.

London and Berlin and Paris are crowded and you are not yet crowded. You have still elbow room here to do what you want.

A CITY DEDICATED ENTIRELY TO POLITICS AND GOVERNMENT

You possess another great advantage in not being a large commercial or manufacturing city. If you had manufactures you would have tall chimneys and, as it seems impossible to enforce an anti-smoke law in a manufacturing city, you would have black smoke, which would spoil the appearance of your finer buildings, especially those constructed of limestone or sandstone, the soot clinging to them as it does now to Westminster Abbey and St. Paul's Cathedral in London. You would not have the same satisfaction in making things beautiful. A murky cloud would hang thick and

ONE OF THE MOST BEAUTIFUL OF WASHING
LOOKING NORTH ON SEVENTEENTH STRE

"As capitals go, few are so advantageously
Washington. All these considerations make on
offered to you for the further adornment and
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more" (see page 719).

Photo by Alfred G. Robinson

IN THE RAPIDS OF THE POTOMAC

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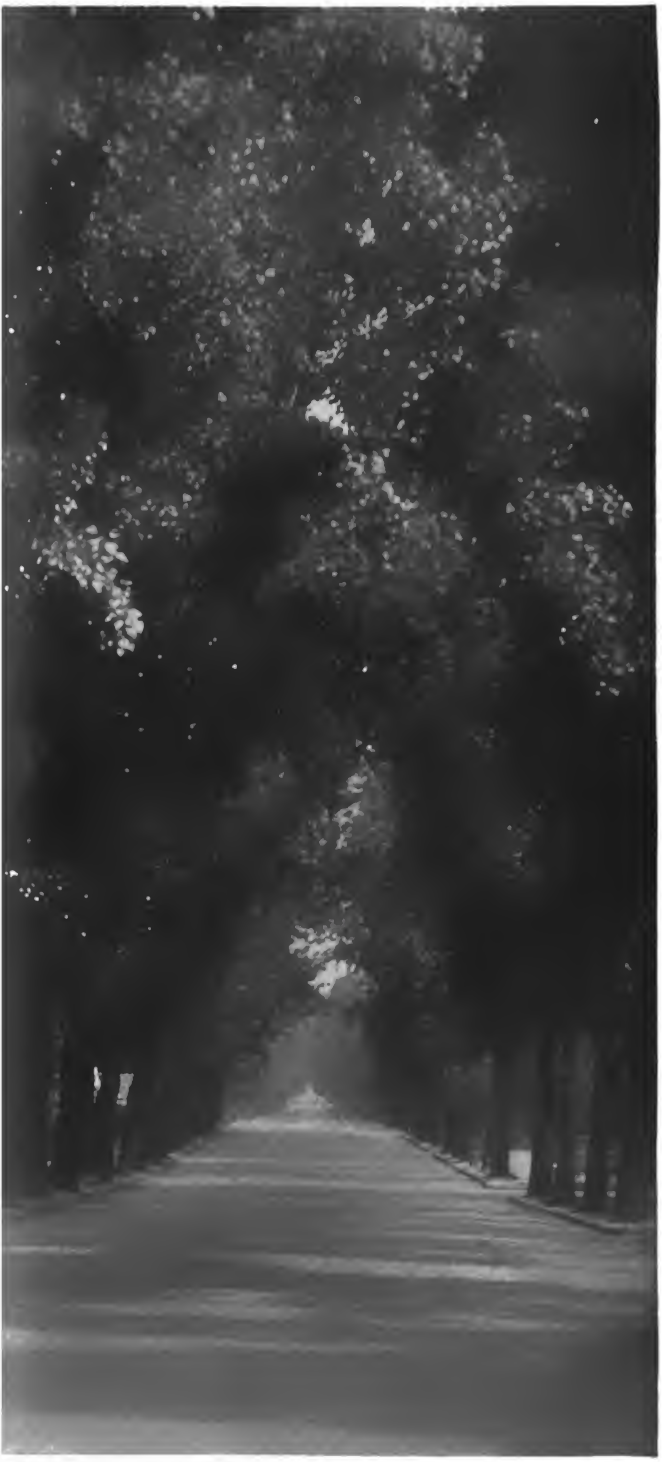
American life, called Washington the City of Conversation. That is a happy characterization, having regard not only to Congress and politics, but also to all the interesting talk that goes on here about science in the Cosmos Club, and elsewhere about many things that are neither scientific nor concerned with any kind of work.

Washington is in a peculiar sense consecrated to society and to the higher charms of life; in fact, to all these things which make the delight of human intercourse; and therefore it is especially fitting that it should be able to live without the continual intrusion of those mighty factors of modern life—industrial production and commercial exchange—which dominate most of the cities of this continent and indeed most of the great cities of the modern world.

WASHINGTON SHOULD BE THE EMBODIMENT OF THE MAJESTY OF THE WHOLE NATION

From all that in Washington you are free, and it is fortunate you are free, because you are able to make a city of a



WASHINGTON STREETS IN EARLY SPRING: A VIEW
ENTH STREET FROM MASSACHUSETTS AVENUE

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AN EARLY MORNING VIEW OF FIFTEENTH STREET, WHICH LATER IN THE DAY BECOMES ONE OF THE BUSIEST THOROUGHFARES IN THE CAPITAL CITY

"We are not to suppose that in thinking of the beauties of the city or country we are thinking of ourselves only, for beauty and ugliness have an effect upon the minds of all classes of residents" (see page 737) already imitated, in the construction of their State capitols, the Capitol at Washington.

What you want is to have a city which every one who comes from Maine, Texas, Florida, Arkansas, or Oregon can admire as being something finer and more beautiful than he had ever dreamed of before; something which makes him even more proud to be an American; something which makes him wish to diffuse the same ideas of beauty through his own State as he sees set forth in visible form here.

You wish to have not only beautiful buildings, but you want to have everything else that makes the externals of life attractive and charming. You wish to have picture galleries. You wish to have museums. You have made advances in that direction already, for you have an admirable and constantly growing National Museum. You have the beginnings of a fine art gallery, and will doubtles add to it a national portrait gallery. Yo have admirable scientific institutions c many kinds, some of which will ult mately be housed in buildings finer th they have yet obtained. Some of the a ministrative departments of the gove ment, especially the scientific depa ments, are organized on a scale such can hardly be found elsewhere.

You have some splendid new bu ings; for instance, the new railway tion, with its two long and noble that yields only to the magnificence new Pennsylvania station in New

You have also the Pan-American ing. That seems to me to be one most finished and graceful, one most happily conceived and skilful cuted buildings that has been anywhere within the last 30 or 4

THE NEED OF A NATIONAL UNI

Let me add that there is one t is still wanting. There ought great National American Uni Washington.

Through no fault either o fessors or of our friend wh with so much wise care over Washington University here. tution has not received those

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those buildings which are needed to make it worthy of the name it bears. This is rather a digression, but I would like to say, as I have mentioned the university, that the suggestion that a great central university is needed does not by any means imply that such an institution should be managed by the nation through Congress, or should necessarily even receive from Congress the funds needed for its support.

You will all agree that a national capital ought to have a great university. It need not be of the same type as the great State universities, nor set itself to do all the things that are done in universities located in or near great cities. You have, for instance, no great industrial establishments here calling for a faculty of engineering or of other practical arts on such a scale as those universities must have, placed as they are, in great commercial centers.

What seems most directly needed is a university dedicated to three kinds of study—to theoretic science, to the arts and the "artistic side of life," and to what are called the human studies of a philological, historical, and political order. There is of course no reason why you should limit your aspirations; but the more immediate need in this city is not for an institution fitting men to enter upon any kind of technical work, in manufacturing or mining or agricultural industry, but for something of a different type.

You ought to have a fully equipped school of law, a complete and well staffed school of political science, and of economics, and therewith, also, a strong school of history. You have already in your government departments an unusually large number of eminent, industrious, and distinguished scientific men, who are one of the glories of Washington, and to match these you must also have a like galaxy of men pursuing those studies, such as history, economics, philology, and law, which are the complement of scientific studies.

Through the liberality of private benefactors, with perhaps some aid from the national government, it will surely be found possible before long to carry out the great idea which the first President had when he urged that a university should be established in this city, which was the darling thought and hope of his old age.

WHAT STILL NEEDS TO BE DONE

I have been invited by some of you to make a few suggestions as to some of the things that may be considered with a view to the beautification of Washington and the turning of its natural advantages to the best account.

It is hardly necessary to observe that there ought to be some method of securing a measure of symmetry and harmony in buildings. The public buildings to be erected should not be planted haphazard. Each building ought to be placed with some reference to the others, so that they will form, if possible, a group together, and all go to make up a good general effect.

In the same way, when laying out the streets, it is proper to consider the lines on which the streets may best be planned, so as to give the best scenic effect and sc as to open up the best vistas. It is wel to make some streets unusually wide, lik 16th street, and to turn them in such way that they shall give the best nortl western and western evening lights, an if possible, a little piece of landscape e fect at the end. Nothing is more charı ing than to see a bit of green landscape trees or a grassy slope—at the end o long street vista. There are some stre in the growing parts of Washing where that can be usefully done.

ODDITY BETTER THAN MONOTONY

I am far from suggesting that should try to attain uniformity in buildings, because uniformity usually in monotony. That can be seen i buildings of Paris. When the city largely rebuilt by Haussman in Napoleon's day, that error was co ted. While many of the bouleva that time are very handsome, or tired of the repetition of the sai signs and structure over and ove

There is no doubt something grotesque in the manner in which houses are placed side by side

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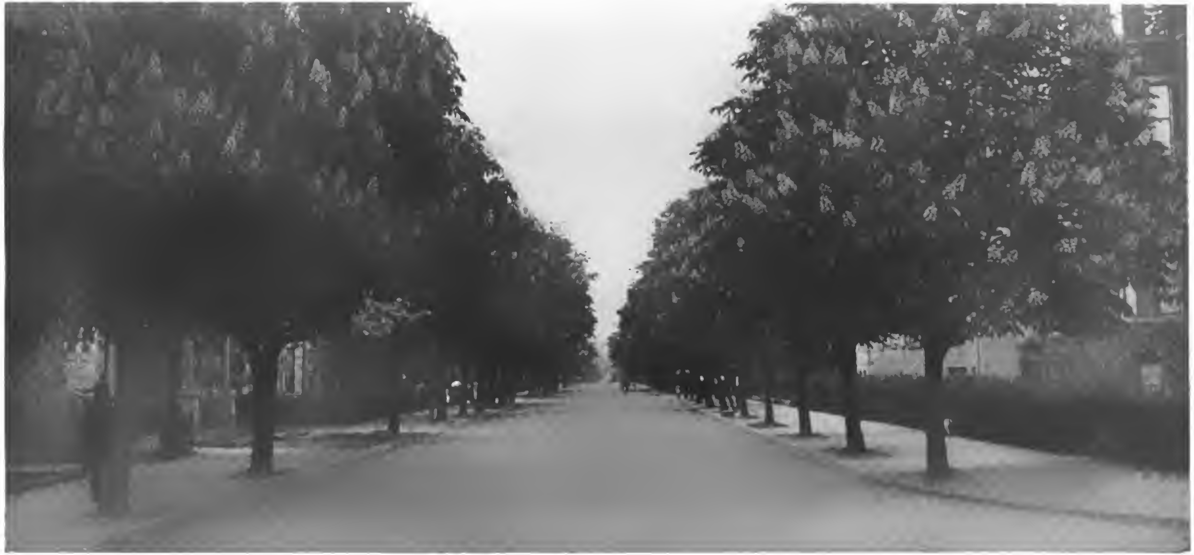

AN AVENUE OF HORSE CHESTNUTS: THIRTEENTH STREET, LOOKING NORTH FROM IOWA CIRCLE effect will be impressive. We must take thought for even the distant future, for we are trustees in this way for posterity, and we want posterity to think well of us. Perhaps, too, a wild growth of small shrubs and herbaceous wild flowers might be encouraged over parts at least of the space, so as to make it as much as possible like a great natural park.

Some of the finest general prospects of Washington are to be had from those hills on the other side of the Anacostia River. Such sites ought to be treated so as to get the greatest effect from them, so that any one looking across from this side will have a pleasing view presented. Small, mean shacks or little groups of hovels ought to be kept off fine sites.

To care for these things ought not to be set down to personal fastidiousness. We are not to suppose that in thinking of the beauties of the city or country we are thinking of ourselves only, for beaut and ugliness have an effect upon th minds of all classes of residents. Ther are many places on the outskirts of th city which have become sordid and ev hideous, owing to the habit of dumpi refuse. It ought to be checked. I not know what the powers of the D trict Commissioners are, but if they h not sufficient power to stop that def ment of nature they ought to be g such power. I suppose this refuse c be burned, and if so it certainly sh be burned, or perhaps buried, so it w not offend those who walk aroun city and see the beauties of our env

A reference to the Potomac lea to speak of the splendid ridge of forming the face of the hills on th ginia side. They have been sadly c by quarries, spoiling the natural of the rocks; but Nature will one pair those blemishes. Perhaps not do so within the lifetime of us, but in the course of years, w and frost and vegetation, licher and grass, Nature will soften th ness of the rocks where the been taken away, and you will a picturesque cliffs along the bar Potomac, with the tall trees li plumage into the sky behind.

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Washington—a large and handsome edifice, perhaps in the style of a French chateau, by the side of a mean little building of brick, or perhaps even of a wooden shack. A piece of castellated Romanesque in granite looks odd beside a colonial house in brick or stucco. Yet even this oddity is a better plan than the monotony of modern Paris or the far duller monotony of Harley street or Gower street in London.

When considering the beautifying of streets, something should be done to take into account the possibilities in the little open-space triangles that you have here in Washington at the intersection of streets and avenues. They are very pleasant places in the summer because they are green; but surely more might be made in a decorative way of them. You need not perhaps put up any more statues, but treat these corners in some ornamental fashion, so as to give them a greater landscape value than they have at present.

Questions relating to the river and the Potomac Park constitute a very large subject. You have, since the low ground along the Potomac has been reclaimed, a magnificent open space, and you have running through it and spread out below it on both sides of the island a magnificent expanse of water that is perhaps the strongest feature in Washington itself for scenic purposes (see page 720).

Much thought ought to be given to the treatment of Potomac Park, on this side the river, and possibly to the ground on the other side also, if you ever gain power to control the other side, so as to produce the best scenic effects.

I do not know whether any of you have been in Calcutta, but if so you will remember the only fine feature of that rather uninteresting city is the broad river and the very large, open grassy park which is called the Maidan, which borders on it. The river Hooghly and the Maidan redeem Calcutta. This park is a sort of huge Maidan for Washington. Ought not pains to be taken to plant groups of trees, some large groups and more small groups, so as to give fine combinations? One day these will grow to the size of old forest trees and the

A CORNER IN MCI

y valuable elements in our Washing- landscape.

t is desirable if possible to stop any ther quarrying on the Potomac cliffs to preserve the trees on the top of se cliffs on the Virginia side, and to ke a good path, a walking path or rid- path, or possibly a not too obtrusive ving road, along the top, looking vn onto the river, from which you ıld get fine prospects. The road might kept a little back, so as not to be con- cuous from below.

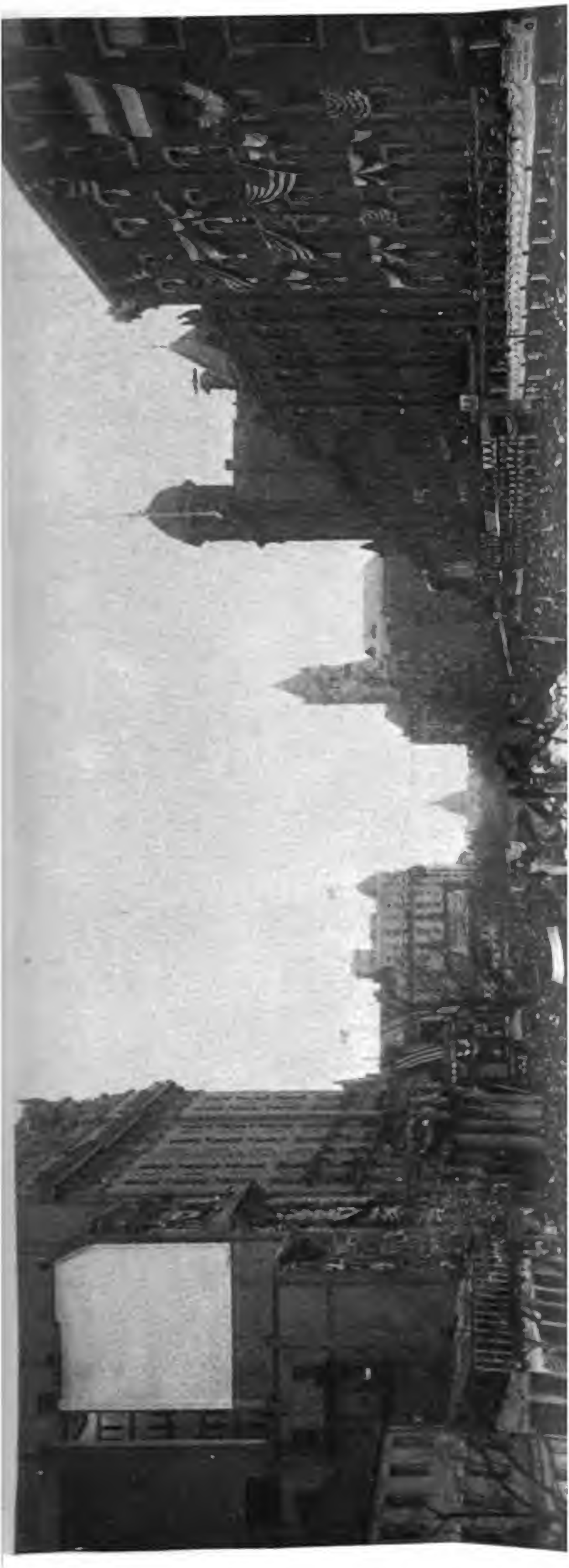
E MOST BEAUTIFUL VIEW OF WASHINGTON IS THREATENED

May I mention a point of view that now threatened and perhaps almost ne? You all know the spot at which isconsin avenue intersects Massachu- ts avenue, which has now been ex- ıded beyond that intersection into the untry. At that point of intersection, st opposite where the Episcopal Cathe- al is to stand, there is one spot com- anding what is one of the most beauti- l general views of Washington. You ɔk down upon the city, you see its most :iking buildings—the Capitol, the Li- ary, State, War, and Navy Depart- ent, and the Post-Office and other high ildings along Pennsylvania avenue— ıd beyond them you see the great sil- ry flood of the Potomac and the soft ıes fading away in dim outline in the r southeast. It is a delightful and in- iring view.

It is a view that reminds one of some those ample prospects over Rome hich the traveler is able to obtain from . Peter Montorio, on the further side the Tiber, or from Monte Mario.

All that piece of land is being now cut , and according to present appearances ouses will be built there immediately, ıd after two years nobody will ever see ıat view again except from the tower f the cathedral when erected. Can it e saved?

There may be other views of Wash- ıgton that are as good, but there is none etter. It is a view that speaks not only o the eye, but to the imagination also. The top of the slope ought to have been



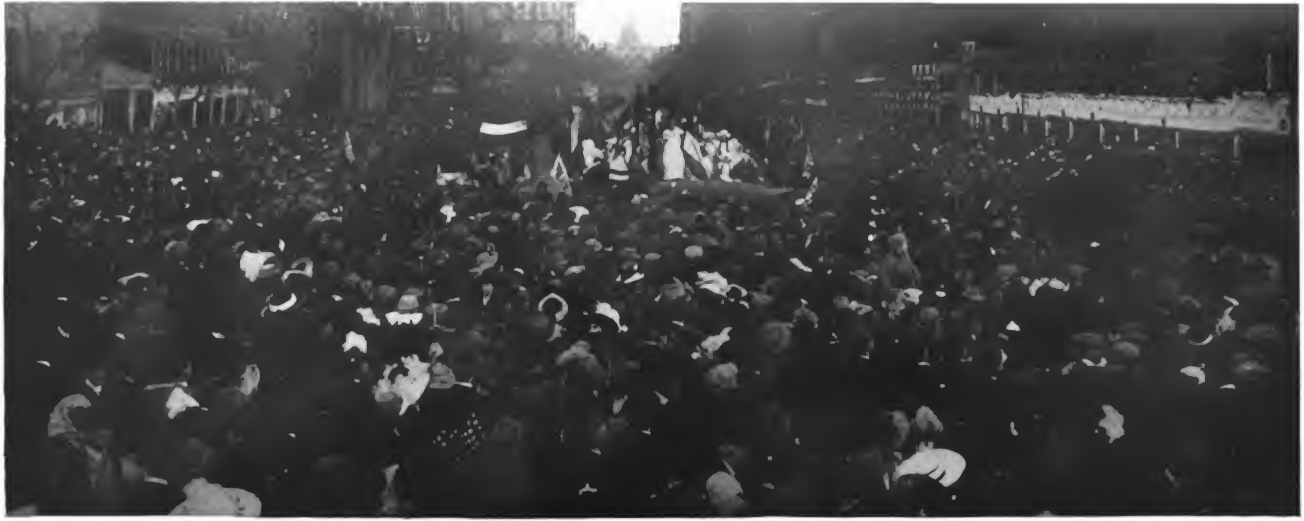
NER IN MCPHERSON SQUARE

THE ENDLE

"Along one part of the with sandy pools; at other and many tiny cascades, wh **boulders**" (see page 738).

cultural purposes or it w turned into cultivation. pears, nothing has been ing done with the land profit out of it. There pieces of woodland of gr ther to the northeast and not all of those woods c at moderate prices. The aged so as to bring in a would with good forestr haps return a profit, or the cost of administratio

What a thing it would ple of Baltimore and Wa an immense open space they could go out on Sat days, especially in the s where they could wan



LOOKING DOWN PENNSYLVANIA AVENUE FROM THE TREASURY BUILDING, SHOWING THE CROWDS WATCHING THE SUFFRAGETTE PARADE ON MARCH 3, 1913: THE CAPITOL MAY BE SEEN IN THE DISTANCE

A FARMING SCE

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Photo by Albert G. Robinson

ETY OF BEAUTY OF ROCK CREEK PARK

there are places where the creek is deep and stagnant,
e water runs swiftly, and there are ripples in the stream
vater splashes over ridges of rock and twists round huge

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their picnic parties, and enjoy these pleasures of nature, which are the simplest and purest that God has bestowed upon his creatures the capacity of enjoying.

Now, you may say this is all very fine and pretty, but where are the funds to come from? Well, considering that the District of Columbia is Uncle Sam's property, and that his purse is a deep one, and that a wide-open region for recreation will become more and more valuable, and the obtaining it more and more costly as time goes on, what you have got to do is to educate public opinion and induce Congress to spend a moderate sum for this purpose, while the people of Baltimore induce their city and the State of Maryland to do the like. No people is really more idealistic than the Ameri-

"What you want is to h
Florida, Arkansas, or Oregor
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Photo by Albert G. Robinson

NE IN THE OUTSKIRTS OF THE NATION'S CAPITAL

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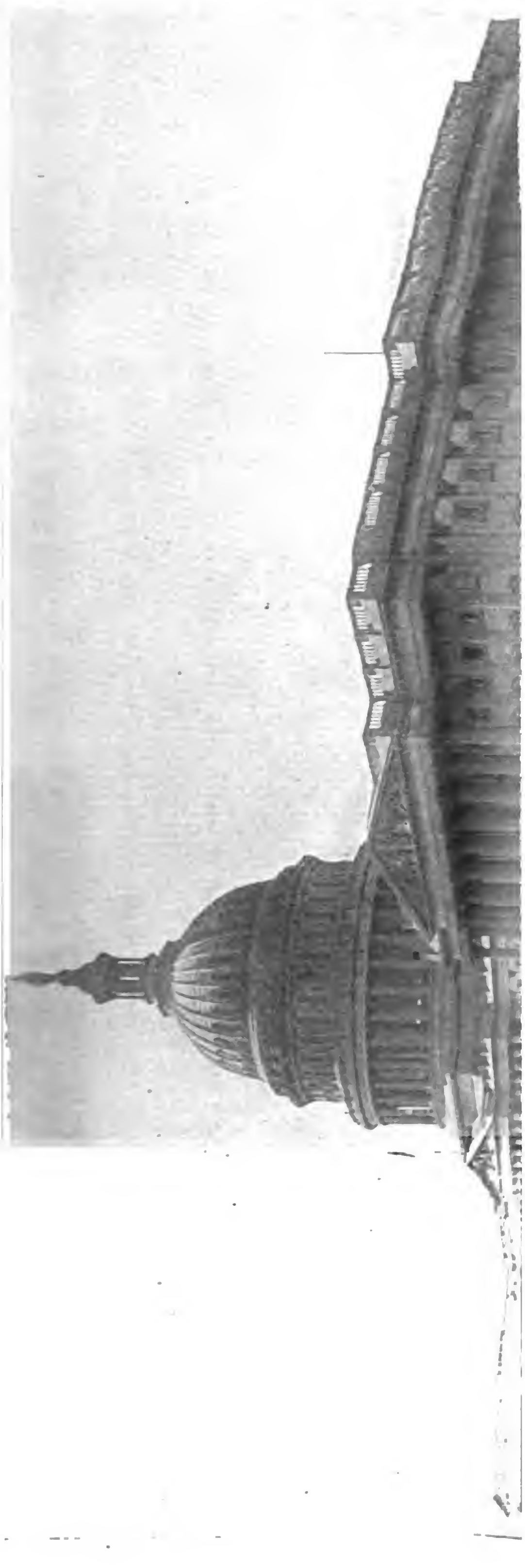
that the country and with it London were going to grow enormously, and that far more space would be needed for our increased traffic. It seems strange now that every man of sense did not foresee this growth and the need for preparing to meet it.

People ought to have realized 80 years ago what the progress of modern science was certain to achieve, what railroads were going to become, what larger facilities for transportation were sure to be required, how coal and steam power were going to increase wealth and industry, and how population would multiply. Whether any European countries will continue to grow as fast in the future as Britain and Germany have grown during the past 80 years, I will not venture to conjecture; but about the continuing increase of wealth and population here in the United States there can be no doubt at all.

GEORGE WASHINGTON'S FORESIGHT

That increase seems destined to continue here for at least a century and a half or two centuries to come, and at the end of that time no one can tell what



) have a city which every one who comes from Maine, Texas, gon can admire as being something finer and more beautiful than before; something which makes him even more proud to be an ch makes him wish to diffuse the same ideas of beauty through et forth in visible form here" (see page 731).

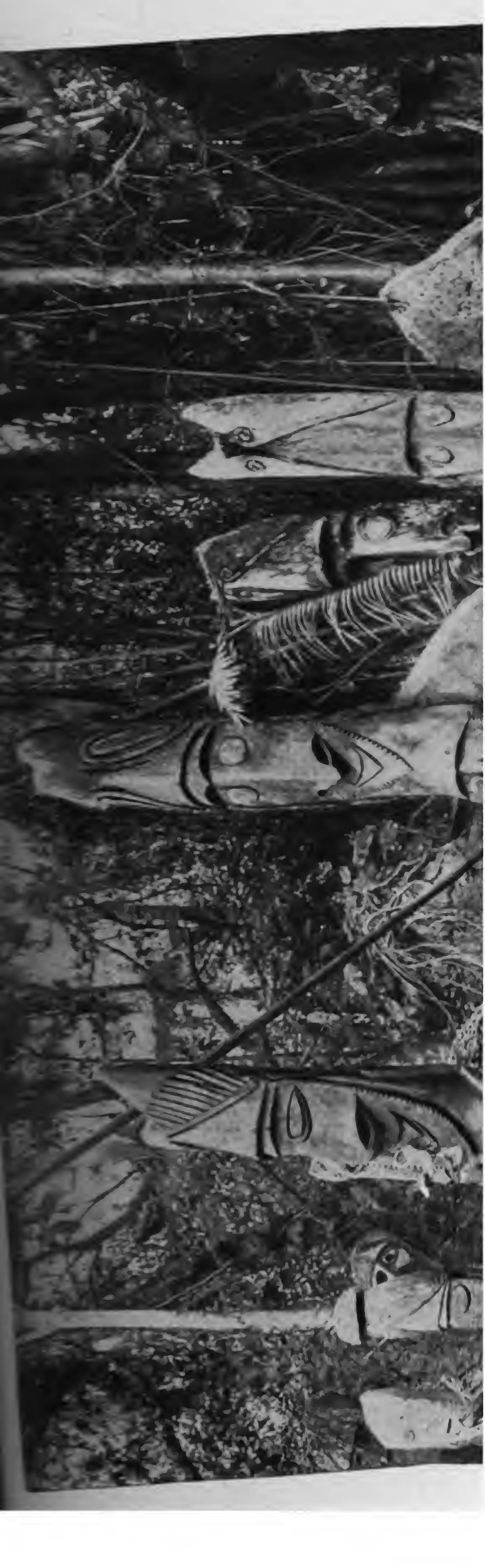
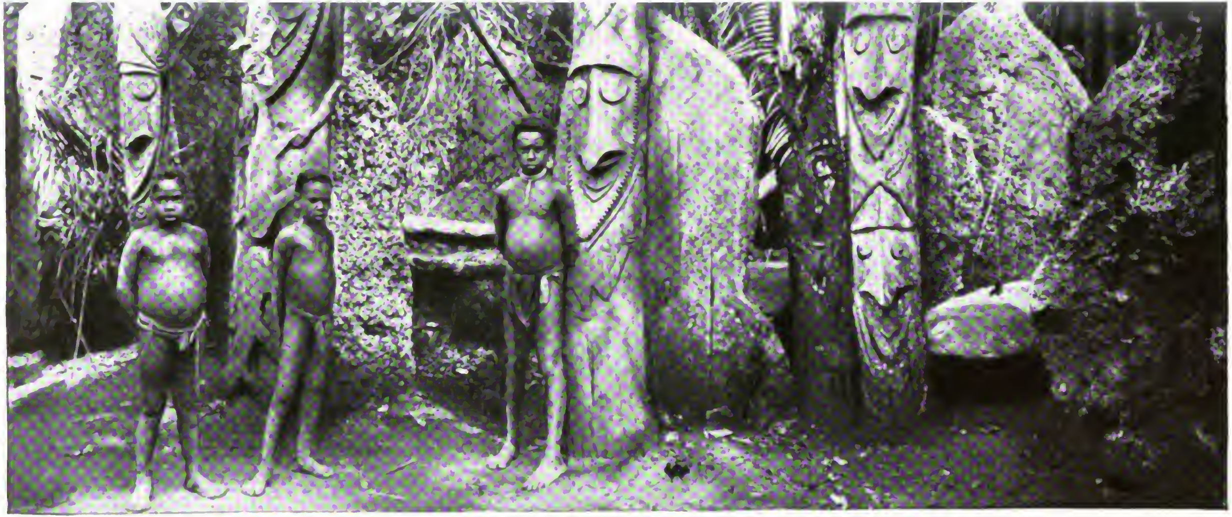


Photo by Leet Bros.

"May not the city of Washington feel that its mission in life is to be the embodiment of the majesty and the stateliness of the whole nation, representing all that is finest in American conception, all that is largest and most luminous in American thought, embodying the nation's ideal of what the capital of such a nation should be" (see page 728).



TABOO SIGNS IN THE NEW HEBRIDES

Outside every village in the New Hebrides taboo signs like those shown in the picture can be found. These queer figures are usually painted in the crudest colors—ochres, vermilions, and blacks—which are truly startling when discovered suddenly. They are erected as reminders of certain prohibitions which have received religious or magical sanction and are known as taboo.

A WHITE FATHER AND HIS PATIENTS

The White Fathers are a congregation of Roman Catholic priests charged with the evangelization of Northern Africa, particularly of the Mohammedans. They were founded in 1868 by the famous Cardinal Lavigerie

The official costume
magnificent embroidery, l
with cloth of gold or silv
it consists of papier-mâc
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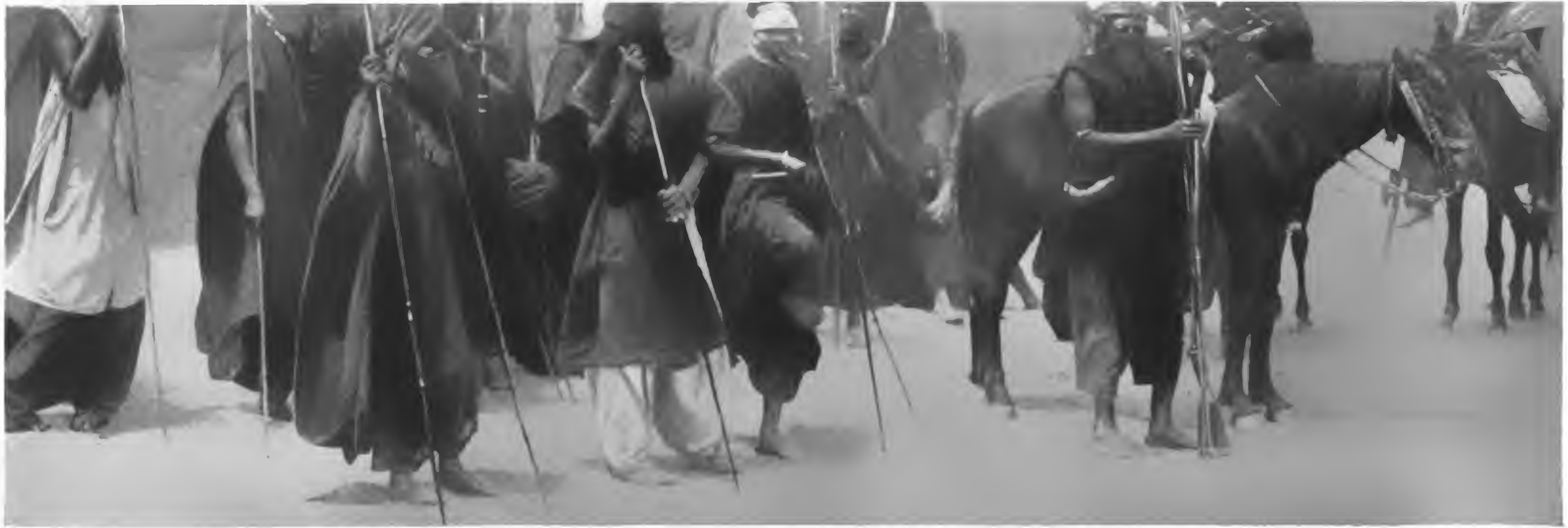
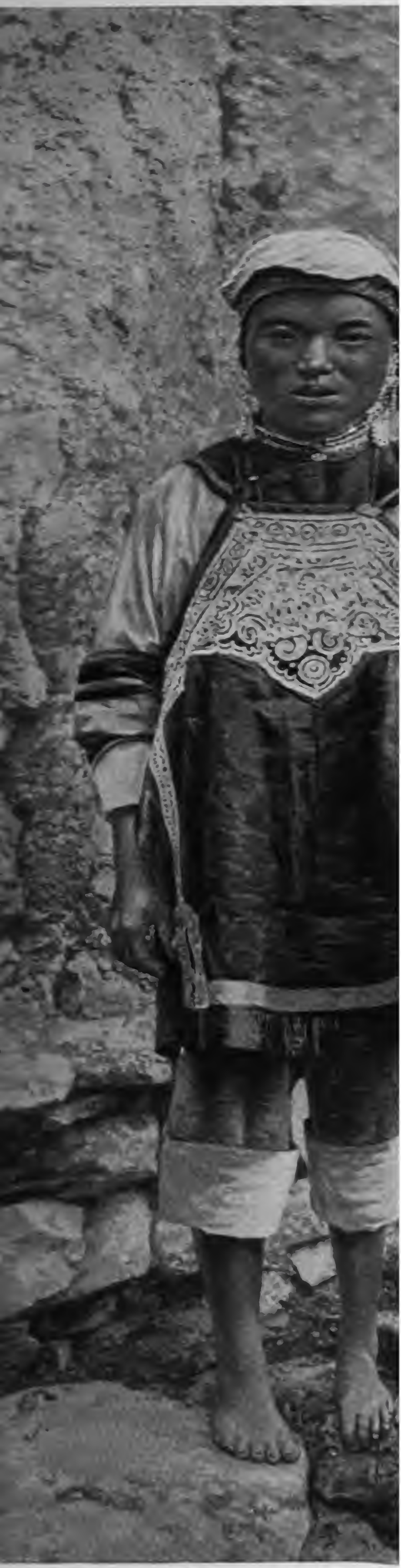


TUAREG CHIEFS WAITING AUDIENCE WITH THE FRENCH COMMANDANT AT TIMBUCTU

The Tuareg is easily recognized by his veil, which he discards under no circumstances, deeming it shameful to be seen with uncovered face. This veil, the *litham*, as it is called, was primarily adopted as a protection from the choking sand of the Sahara. It is also used by European travelers, who find that it prevents thirst to a remarkable extent. The Tuaregs had at one time a very bad reputation, but have been reduced to comparative quiet, as the strong arm of France has made itself more and more felt throughout the Sahara.



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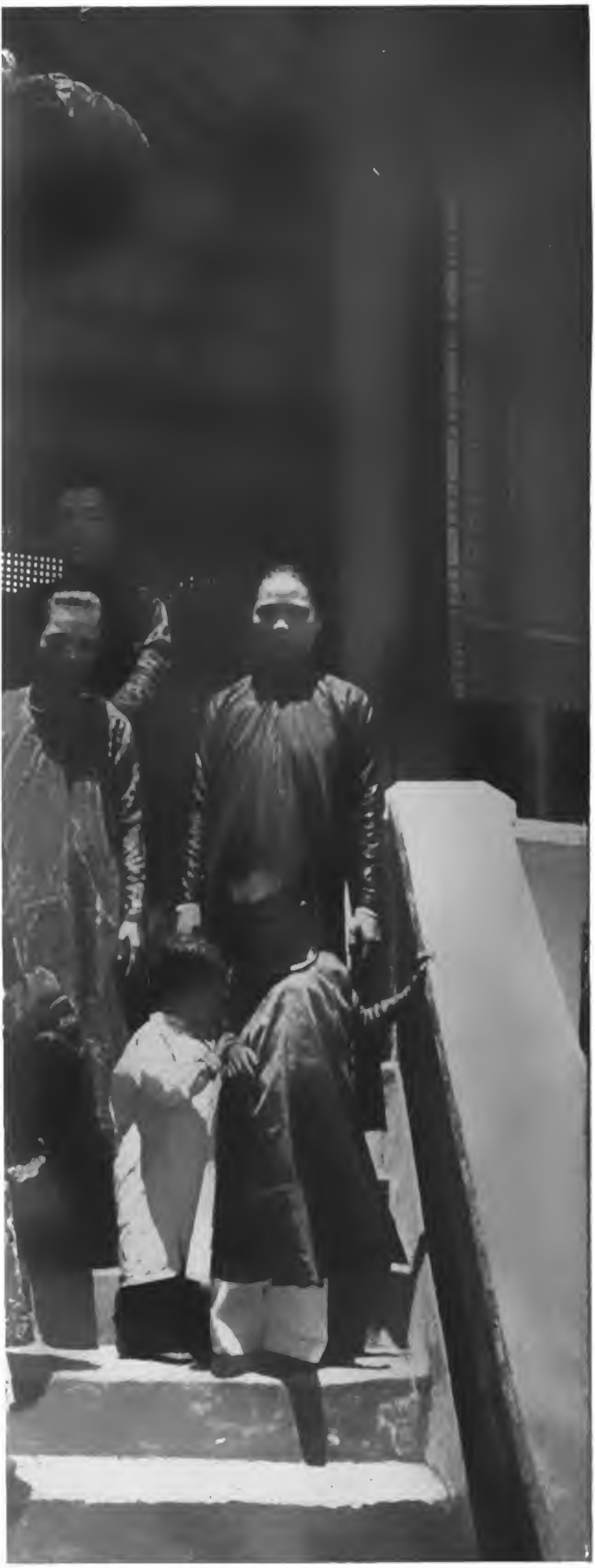
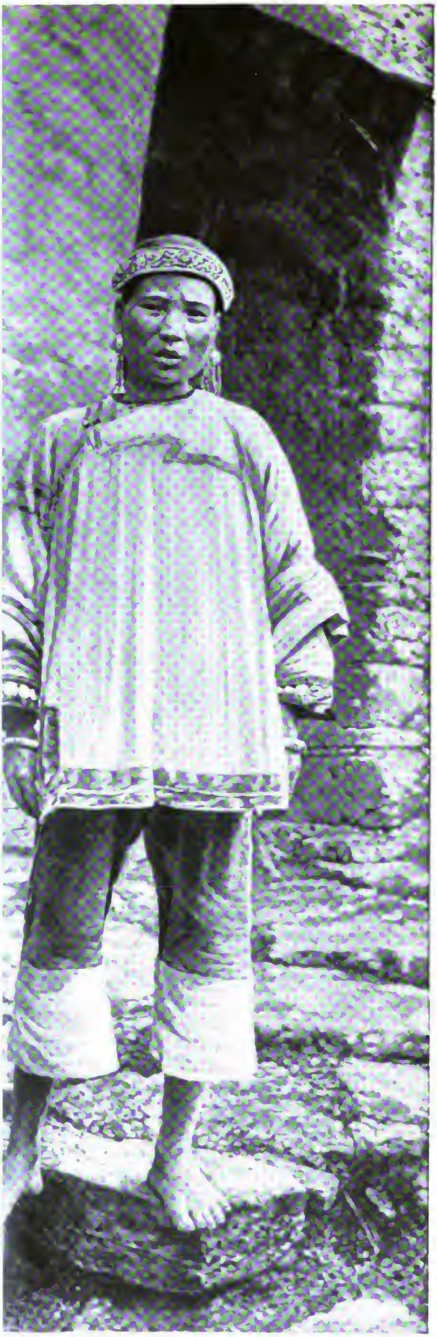


rin in Annam is a rich robe of silk, covered with
ous open sleeves, lined with silk of another color or
l-dress is the most curious part of the official insignia;
orately lacquered and gilded, in shape not unlike a
him a canopy of scented grass or feathers.



WOMEN

nce of Yunnan, the southwesternmost division
ost intractable under Chinese rule. They are a
most industrious types in China. Outside of
ving manned the government mines since their
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who have also a great reputation as dancers.

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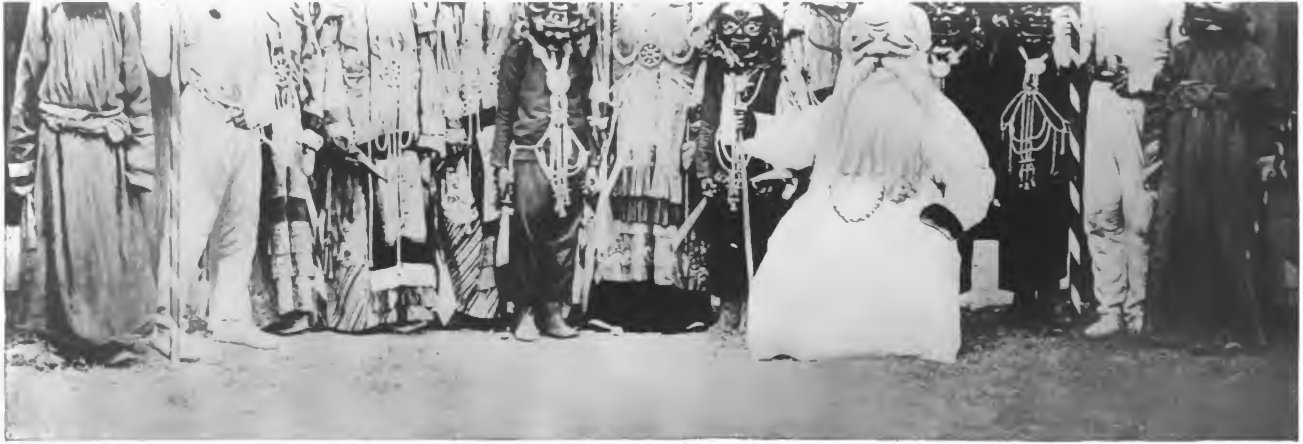

A GROUP OF ACTORS IN THE TSAME FESTIVAL

From time to time, at every lamasery in Tibet, Mongolia, and Siberia, these festivals are held, the chief attraction being what has become known among Europeans as "devil dances." This is quite a misnomer, for the dances are really approximate to the mediæval miracle play. The participants are the monks of the lamasery, who, in costume and mask, represent gods, devils, mythological kings, and other characters traditional in the dance. In the center of the picture we see one of the gods with two unmasked attendants; the four small masked figures are imps, and at each end are a countryman and a skeleton; two lesser gods complete the group. The venerable figure with the long, white beard is one of the sages who relates the story as the dance progresses.

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